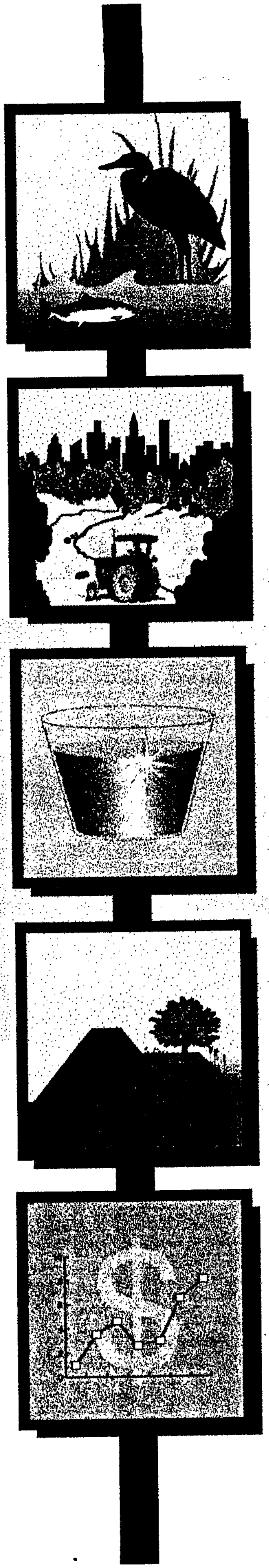
RON OTT/SAC



CALFED
BAY-DELTA
PROGRAM

# DNCT
# EWA Gaming Workbook

APPENDIX 2

# Water Aquisition

# Water Transfer Options and Rules for Use in EWA Gaming

| Region | Market Type | Transfer Type | fallowing subsets (quanty is not additive) | Annual Quantity (1,000 af) | Option Price ($/af) | Cost ($/af) | Delay Risk Factor | Potential Delay (months) |
|---|---|---|---|---|---|---|---|---|
| **Sacramento Valley** | | | | | | | | |
| | 1-year spot (ave year) | Storage | | 150 | n/a | 50 | 0.1 | 2 |
| | | Fallowing | (by Feb 1) | 100 | n/a | 50 | 0.1 | 2 |
| | | Fallowing | (by April 1) | 100 | n/a | 75 | 0.2 | 2 |
| | | Fallowing | (by May 1) | 100 | n/a | 100 | 0.3 | 2 |
| | | GW/CU | | 100 | n/a | 100 | 0.5 | 4 |
| | 1-year spot (dry year) | Storage | | 100 | n/a | 100 | 0.2 | 4 |
| | | Fallowing | (by Feb 1) | 100 | n/a | 175 | 0.2 | 4 |
| | | Fallowing | (by April 1) | 100 | n/a | 250 | 0.4 | 4 |
| | | Fallowing | (by May 1) | 100 | n/a | 300 | 0.5 | 4 |
| | | GW/CU | | 100 | n/a | 200 | 0.5 | 8 |
| | 10-year option | Storage | | 75 | 20 | 75 | 0.05 | 2 |
| | | Fallowing | (by Feb 1) | 75 | 20 | 150 | 0.1 | 3 |
| | | Fallowing | (by April 1) | 50 | 20 | 175 | 0.1 | 3 |
| | | Fallowing | (by May 1) | 40 | 20 | 200 | 0.1 | 3 |
| | | GW/CU | | 100 | 20 | 150 | 0.05 | 6 |
| | 10-year lease | Storage | | 50 | n/a | 150 | 0 | n/a |
| | | GW/CU | | 50 | n/a | 150 | 0 | n/a |
| | | Diversion right (for instream flow only) | | 15 | n/a | 100 | 0 | n/a |
| **San Joaquin Tribs** | | | | | | | | |
| | 1-year spot (ave year) | Storage | | 60 | n/a | 50 | 0.1 | 2 |
| | | Fallowing | (by Feb 1) | 50 | n/a | 50 | 0.1 | 3 |
| | | Fallowing | (by April 1) | 50 | n/a | 75 | 0.2 | 3 |
| | | Fallowing | (by May 1) | 50 | n/a | 100 | 0.3 | 3 |
| | | GW/CU | | 50 | n/a | 100 | 0.5 | 6 |
| | 1-year spot (dry year) | Storage | | 60 | n/a | 100 | 0.2 | 4 |
| | | Fallowing | (by Feb 1) | 50 | n/a | 175 | 0.2 | 4 |
| | | Fallowing | (by April 1) | 50 | n/a | 250 | 0.4 | 4 |
| | | Fallowing | (by May 1) | 50 | n/a | 300 | 0.5 | 4 |
| | | GW/CU | | 50 | n/a | 200 | 0.5 | 8 |
| | 10-year option | Storage | | 50 | 20 | 75 | 0.05 | 2 |
| | | Fallowing | (by Feb 1) | 50 | 20 | 150 | 0.1 | 3 |
| | | Fallowing | (by April 1) | 40 | 20 | 175 | 0.1 | 3 |
| | | Fallowing | (by May 1) | 30 | 20 | 200 | 0.1 | 3 |
| | | GW/CU | | 50 | 20 | 150 | 0.05 | 6 |

**Rules:**
Limited to 50% of needed quantity from spot market. Rest must be purchased through options or leases. Water optained from spot, option, or lease markets are additive. Cannot add spot markets - only get ave or dry, not both in any one year.

**Fallowing:** The alternatives within a market type cannot be added.

**Risk factors** mean that a transfer may be delayed or not permitted.

**Option Mkt Rules:**
Only use option 5 years out of 10 and no more than 3 years in a row.



D-016275

# Water Transfer Options and Rules for Use in EWA Gaming

D-016276

| Region | Market Type | Transfer Type | fallowing subsets (quanty is not additive) | Annual Quantity (1,000 af) | Option Price ($/af) | Cost ($/af) | Delay Risk Factor | Potential Delay (months) |
|---|---|---|---|---|---|---|---|---|
| | 10-year lease | Storage | | 25 | n/a | 150 | 0 | n/a |
| | | GW/CU | | 30 | n/a | 150 | 0 | n/a |
| | | Diversion right (for instream flow only) | | | | | | |
| **Export Area** | | | | | | | | |
| | 1-year spot | Conservation | | 50 | n/a | 100 | 0.2 | 2 |
| | (ave year) | Storage | | 50 | n/a | 100 | 0.3 | 3 |
| | | Fallowing | (by Feb 1) | 150 | n/a | 150 | 0.3 | 3 |
| | | Fallowing | (by April 1) | 150 | n/a | 200 | 0.4 | 3 |
| | | Fallowing | (by May 1) | 150 | n/a | 300 | 0.5 | 3 |
| | | GW/CU | | 100 | n/a | 150 | 0.1 | 2 |
| | 1-year spot | Conservation | | 30 | n/a | 150 | 0.2 | 4 |
| | | Fallowing | (by Feb 1) | 100 | n/a | 175 | 0.2 | 4 |
| | | Fallowing | (by April 1) | 100 | n/a | 250 | 0.4 | 4 |
| | | Fallowing | (by May 1) | 100 | n/a | 300 | 0.5 | 4 |
| | | GW/CU | | 150 | n/a | 200 | 0.2 | 4 |
| | 10-year option | Conservation | | 30 | 20 | 100 | 0.05 | 2 |
| | | Fallowing | (by Feb 1) | 100 | 20 | 150 | 0.1 | 3 |
| | | Fallowing | (by April 1) | 75 | 20 | 175 | 0.1 | 3 |
| | | Fallowing | (by May 1) | 50 | 20 | 200 | 0.1 | 3 |
| | | GW/CU | | 100 | 20 | 150 | 0.05 | 2 |
| | 10-year lease | Conservation | | 20 | n/a | 100 | 0 | n/a |
| | | GW/CU | | 50 | n/a | 150 | 0 | n/a |

D-016276

D-016277

# Wat Transfer Options and Rules for Use in EWA Gamin

IO A quantity

| Region | Market Type | Transfer Type | fallowing subsets (qunty is not additive) | Annual Quantity (1,000 af) | Option Price ($/af) | Cost ($/af) | Delay Risk Factor | Potential Delay (months) |
|---|---|---|---|---|---|---|---|---|
| **Sacramento Valley** | | | | | | | | |
| | 1-year spot (ave year) | Storage | | 150 | n/a | 50 | 0.1 | 2 |
| | | Fallowing | (by Feb 1) | 100 | n/a | 50 | 0.1 | 2 |
| | | Fallowing | (by April 1) | 100 | n/a | 75 | 0.2 | 2 |
| | | Fallowing | (by May 1) | 100 | n/a | 100 | 0.3 | 2 |
| | | GW/CU | | 100 | n/a | 100 | 0.5 | 4 |
| | 1-year spot (dry year) | Storage | | 100 | n/a | 100 | 0.2 | 4 |
| | | Fallowing | (by Feb 1) | 100 | n/a | 175 | 0.2 | 4 |
| | | Fallowing | (by April 1) | 100 | n/a | 250 | 0.4 | 4 |
| | | Fallowing | (by May 1) | 100 | n/a | 300 | 0.5 | 4 |
| | | GW/CU | | 100 | n/a | 200 | 0.5 | 8 |
| | 10-year option | Storage | | 75 | 20 | 75 | 0.05 | 2 |
| | | Fallowing | (by Feb 1) | 75 | 20 | 150 | 0.1 | 3 |
| | | Fallowing | (by April 1) | 50 | 20 | 175 | 0.1 | 3 |
| | | Fallowing | (by May 1) | 40 | 20 | 200 | 0.1 | 3 |
| | | GW/CU | | 100 | 20 | 150 | 0.05 | 6 |
| | 10-year lease | Storage | | 50 | n/a | 150 | 0 | n/a |
| | | GW/CU | | 50 | n/a | 150 | 0 | n/a |
| | | Diversion right (for instream flow only) | | 15 | n/a | 100 | 0 | n/a |
| **San Joaquin Tribs** | | | | | | | | |
| | 1-year spot (ave year) | Storage | | 60 | n/a | 50 | 0.1 | 2 |
| | | Fallowing | (by Feb 1) | 50 | n/a | 50 | 0.1 | 3 |
| | | Fallowing | (by April 1) | 50 | n/a | 75 | 0.2 | 3 |
| | | Fallowing | (by May 1) | 50 | n/a | 100 | 0.3 | 3 |
| | | GW/CU | | 50 | n/a | 100 | 0.5 | 6 |
| | 1-year spot (dry year) | Storage | | 60 | n/a | 100 | 0.2 | 4 |
| | | Fallowing | (by Feb 1) | 50 | n/a | 175 | 0.2 | 4 |
| | | Fallowing | (by April 1) | 50 | n/a | 250 | 0.4 | 4 |
| | | Fallowing | (by May 1) | 50 | n/a | 300 | 0.5 | 4 |
| | | GW/CU | | 50 | n/a | 200 | 0.5 | 8 |
| | 10-year option | Storage | | 50 | 20 | 75 | 0.05 | 2 |
| | | Fallowing | (by Feb 1) | 50 | 20 | 150 | 0.1 | 3 |
| | | Fallowing | (by April 1) | 40 | 20 | 175 | 0.1 | 3 |
| | | Fallowing | (by May 1) | 30 | 20 | 200 | 0.1 | 3 |
| | | GW/CU | | 50 | 20 | 150 | 0.05 | 6 |
| | 10-year lease | Storage | | 25 | n/a | 150 | 0 | n/a |
| | | GW/CU | | 30 | n/a | 150 | 0 | n/a |
| | | Diversion right (for instream flow only) | | | | | | |

**Rules:** Limited to 50% of needed quantity from spot market. Rest must be purchased through options or leases. Water optained from spot, option, or lease markets are additive. Cannot add spot markets - only get ave or dry, not both in any one year.

**Fallowing:** The alternatives within a market type cannot be added.

**Risk factors** mean that a transfer may be delayed or not permitted.

**Option Mkt Rules:** Only use option 5 years out of 10 and no more than 3 years in a row.

spread sheet

D-016277

## Wat Transfer Options and Rules for Use in EWA Gaming

| Region | Market Type | Transfer Type | fallowing subsets (qunty is not additive) | Annual Quantity (1,000 af) | Option Price ($/af) | Cost ($/af) | Delay Risk Factor | Potential Delay (months) |
|---|---|---|---|---|---|---|---|---|
| **Westside SJ Valley** | | | | | | | | |
| | 1-year spot | Conservation | | 20 | n/a | 100 | 0.2 | 3 |
| | (ave year) | Fallowing | (by Feb 1) | 100 | n/a | 100 | 0.25 | 3 |
| | | Fallowing | (by April 1) | 100 | n/a | 130 | 0.4 | 3 |
| | | Fallowing | (by May 1) | 100 | n/a | 150 | 0.5 | 3 |
| | 1-year spot | Conservation | | 15 | n/a | 150 | 0.3 | 4 |
| | (dry year) | Fallowing | (by Feb 1) | 50 | n/a | 200 | 0.3 | 4 |
| | | Fallowing | (by April 1) | 50 | n/a | 250 | 0.4 | 4 |
| | | Fallowing | (by May 1) | 50 | n/a | 300 | 0.5 | 4 |
| | 10-year option | Conservation | | 15 | 20 | 100 | 0.05 | 2 |
| | | Fallowing | (by Feb 1) | 100 | 20 | 150 | 0.1 | 3 |
| | | Fallowing | (by April 1) | 75 | 20 | 175 | 0.1 | 3 |
| | | Fallowing | (by May 1) | 50 | 20 | 200 | 0.1 | 3 |
| | 10-year lease | Conservation | | 15 | n/a | 100 | 0 | n/a |
| **Tulare Basin/Friant** | | | | | | | | |
| | 1-year spot | Conservation | | 40 | n/a | 100 | 0.2 | 2 |
| | (ave year) | Storage | | 50 | n/a | 100 | 0.3 | 3 |
| | | Fallowing | (by Feb 1) | 50 | n/a | 150 | 0.3 | 3 |
| | | Fallowing | (by April 1) | 50 | n/a | 200 | 0.4 | 3 |
| | | Fallowing | (by May 1) | 50 | n/a | 300 | 0.5 | 3 |
| | | GW/CU | | 100 | n/a | 150 | 0.1 | 2 |
| | 1-year spot | Conservation | | 20 | n/a | 150 | 0.2 | 4 |
| | (dry year) | Storage | | 60 | n/a | 100 | 0.3 | 4 |
| | | Fallowing | (by Feb 1) | 75 | n/a | 175 | 0.2 | 4 |
| | | Fallowing | (by April 1) | 75 | n/a | 250 | 0.4 | 4 |
| | | Fallowing | (by May 1) | 75 | n/a | 300 | 0.5 | 4 |
| | | GW/CU | | 150 | n/a | 200 | 0.2 | 4 |
| | 10-year option | Conservation | | 20 | 20 | 100 | 0.05 | 2 |
| | | Storage | | 50 | 20 | 100 | 0.1 | 2 |
| | | Fallowing | (by Feb 1) | 75 | 20 | 150 | 0.1 | 3 |
| | | Fallowing | (by April 1) | 50 | 20 | 175 | 0.1 | 3 |
| | | Fallowing | (by May 1) | 40 | 20 | 200 | 0.1 | 3 |
| | | GW/CU | | 100 | 20 | 150 | 0.05 | 2 |
| | 10-year lease | Conservation | | 20 | n/a | 100 | 0 | n/a |
| | | Storage | | 40 | n/a | 100 | 0 | n/a |
| | | GW/CU | | 50 | n/a | 150 | 0 | n/a |

D-016278

D-016278

Water Acquisition Group
Proposed Approach to
Scenarios for Modelling and Gaming
David Fullerton
March 9, 1999

I propose that we develop our scenario in several steps as outlined below:

1. Inventory year 1 opportunities (Usable in the year 2000). Include operational constraints such as input, output, throughput, storage maxima, priorities w/r basic Project Operations, etc. Base upon No Name results and recent work by Walthall et al. A reasonable list (which still needs to be filled out w/r constraints) might be:

    - Interim South Delta Program – 8500 cfs.
    - Joint point of diversion (full, unlimited)
    - Kern Water Bank (? KAF)
    - Semitropic high priority
    - Semitropic low priority
    - General rescheduling, exchanges, and demand shifting
    - Water purchases and transfers (? KAF). (Maybe can be more specific – purchase from Kern, purchase from Yuba, etc.)
    - Variable pumping at Tracy Pumping Plant
    - Modification of E/I standard
    - Allow variances (by EWA) to AFRP in-Delta operations.

2. Inventory year 8 opportunities. Include operational constraints. Base upon No Name results.

    - Interim South Delta Program – 10,300 cfs.
    - Joint point of diversion (full, unlimited)
    - DMC/California Aqueduct physical intertie (possibly not needed if the first two measures occur)
    - Small enlargement of Shasta Dam by 6.5 feet (adding roughly 300 TAF of new storage)
    - 240 TAF of in-Delta storage (for the purpose of this analysis the Delta Wetlands Project was used; CALFED proposals for in-Delta storage could also be considered)
    - Kern Water Bank
    - Semitropic high priority
    - Semitropic low priority
    - Additional groundwater storage?
    - Additional surface water storage?
    - Cross Valley Canal exchanges
    - General rescheduling, exchanges, and demand shifting
    - Southern California conjunctive use

- Water purchases and transfers. (Can we expand list?)
- Variable pumping at Tracy Pumping Plant
- Modification of E/I standard
- Modification of other standards?
- Allow variances (by EWA) to AFRP in-Delta operations.
- Purchase water efficiency

3. For Year 1 and Year 8, develop specific scenarios to be used for modelling and gaming. Develop at least 1 scenario for each in which the projects control all new facilities and, in return, grant certain operational rights to the EWA (e.g., x cfs days of reductions per year). The scenarios must be at a level of detail sufficient for modelling and gaming. In some cases, we may wish to hardwire operational choices into the modelling. In other cases, we will want to leave operational decisions outside the models and deal with them by hand in the gaming. We must also generate operational rules adequate for the gaming (priorities for using facilities.

   In practice, we will need to work closely with the bio team. If they go heavily prescriptive, then we will need to assign more supply benefits to the Projects. If they go heavily into real-time (e.g., meet AFRP in-Delta with EWA), then we must assign more assets to EWA.

As an example, for Year 1:

**Baseline for Modelling:** ACCORD + VAMP + AFRP UPSTREAM + AFRP IN-DELTA + Trinity.

Supplies and division of benefits:

- Interim South Delta Program – 8500 cfs. Controlled exclusively by Projects. Include in model
- Joint point of diversion (full, unlimited). Controlled exclusively by Projects. Include in model.
- Kern Water Bank (? KAF of high priority, refillable storage. Constraints = ?). Controlled by EWA. Do not include in model. 300 KAF
- Semitropic high priority (? KAF under contract with Santa Clara. Constraints = ?). Controlled by EWA. Do not include in model.
- Semitropic low priority (? KAF. Constraints = ?) Controlled by EWA. Do not include in model.
- General rescheduling, exchanges, and demand shifting. 100 KAF of options with MWD.) (probably couple to purchase option from Yuba to assure repayment). Controlled by EWA. Do not include in model. 100
- Water purchases and transfers (? KAF). How much? Quantify direct purchases, options and locations. Controlled by EWA. Purchased [illegible]
- Variable pumping at Tracy Pumping Plant. None.
- Modification of E/I standard. Complete relaxation tied to annual contract for water generated by E/I relaxation + JPOD + South Delta improvements (+ Any

storage assigned to the Projects). Will require modelling to determine amount of water for contract. Include contract amount as new demand upon the Projects for modelling purposes. For first cut, deliver to San Luis each year in the fall in the model. Then manage by hand. For later cuts, need more sophisticated treatment (e.g., allow users to prepay this debt using empty environmental storage or by assigning Project storage to EWA. Also, delivery in fall not totally compatible with yield increase estimates, since Project demand assumed increased deliveries spread over the entire year).

- Allow variances (by EWA) to AFRP in-Delta operations. Controlled by EWA. Do not model, but does require modelled estimates of reduced pumping available through variances for each month as an output of the model.

Operational Priorities/ Protocols:

- EWA has rights to accrue debts only to the extent that it can assure no harm.
- EWA may transfer Project upstream storage to south of Delta storage, provided that it can assure no harm.
- EWA may use unused capacity in the Projects.
- Unless otherwise specified, EWA has the lowest priority for access to infrastructure.

Modelling and Gaming.

The model output will represent estimated Project deliveries and will provide the foundation for a gaming exercise.

# Integration

Date: Tue, 1 Jun 1999 13:09:57 -0700 (PDT)
X-Sender: ckoehler@pop2.igc.org (Unverified)
X-Mailer: Windows Eudora Pro Version 2.2 (16)
To: CCWD Water Resources <wrccwd@ccnet.com>, ronott@water.ca.gov,
dafef@water.ca.gov, bherbold@aol.com
From: "Cynthia L. Koehler" <ckoehler@econet.org>
Subject: Re: Legal, institutional, and contractual issues group
Cc: abrandt@ios.doi.gov, Hagler.Tom@epamail.epa.gov, Patrick@resources.ca.gov

Dave -- Thanks for sending over your thoughts re the institutional issues associated with an EWA. A few quick reactions.

1. Framing the issue as addressing "barriers" to an EWA is probably not the appropriate focus as a first step. This assumes an EWA is an inherently useful and important tool, and it may well be. But as we have said for many months, this is not a conclusion that our Caucus will reach until we are satisfied that the political/legal/institutional issues around an account can be satisfactorily resolved. The larger question is; Can a water account be made to be a workable tool in conjunction with CALFED's larger restoration objectives?

2. For similar reasons, it would probably be a mistake for the institutional questions to focus on near term implementation. Again, we see the issue as whether a water account could provide some assurance of environmental water being made available to meet the restoration performance standards over the long term. The political/legal/institutional questions this raises go to long-term implementation. It is far more prudent to determine what you need to do for the long term, and back out of that how to structure any near-term implementation.

3. FYI, the list of issues raised by the enviro groups in their letter to Babbitt of Dec. 9, 1998 is the starting point for our thinking on the institutional questions raised by a water account:

a. What is the baseline for the account?

b. How is DOI planning to reconcile its positions re the possibility/impossibility of accounting for environmental water in the water account discussions with its position in the b2 litigation?

c. Once "dedicated" to the environment, what assurance mechanisms can be devised to guarantee that water "credited" to the enviornment is actually provided to the environment?

d. What is the role, if any. of an instream water right in this regard?

e. What assurance mechanisms can be developed to guarantee that the decisions made by the account managers will be in the best interest of the environment? What will be the institutional relationship between the account managers and the project managers?

f. What safeguards will there be against the politicization of the process of making decisions regarding the account?

Even more fundamentally, someone -- either this group or others -- needs to articulate what is the purpose of a water account? It is apparent that notions of what such an account is for have shifted considerably over the last six months. Without a common -- and absolutely clear, unfudged, unfinessed, unequivocal, litigation-proof -- understanding of what this mechanism is intended to do and not to do, it is likely to create far more problems than it would resolve.

The more technical issues raised in your e-mail are certainly important -- but they assume a level of buy-in and certainty around the account concept that almost certainly will not be available unless and until some of the more basic questions raised above have been addressed to everyone's satisfaction.

Cynthia

At 02:52 PM 5/26/99 -0700, CCWD Water Resources wrote:
>Ron, Bruce, Dave-
>
>Here is what I passed to Cynthia last week. We could overwhlem this group
>if we burden it with too many legal or goverance or financial issues.
>Someone suggested spinning off the legal issues to a subgroup with attorney
>membership if we identify the need as the group begins to work.
>
>It seems that the greatest use this group could perform would be to
>identify the most likely elements of an EWA (JPOD?) and then begin to
>identify and frame the outstanding issues for implementation.
>
>Dave B.
>
>------------------------------------------------------------------------
>----------
>Suggested role of the group:
>
>1. Investigate and anticipate any legal, institutional, and contractual
>barriers as the EWA develops.
>2. Advise management/DNCT
>
>Purpose/charge/scope:
>
>My belief is that this group's main purpose would be the identification of
>barriers to EWA implementation - a directive for the DNCT given last week
>by Mike Spear. I think the focus should be on near-term implementation
>(Day 1, Stage 1) but I could be wrong. After identification, the group

>could maybe serve a role with resolution through suggested solutions, but
>the primary and first task would be identification.
>
>I assume the idea would be to examine the most likely (or probable)
>elements of the EWA and then begin to think through the hypothetical
>implementation issues. Each element (e.g., JPOD or water purchases or use
>of Project storage) would need to be considered with respect to:
>contractual arrangements if Project facilities are used, potential for
>conflicting/competing water purchases and relationship to other water
>transfers, consistency with existing and future water rights frameworks,
>and consistency with current consultations with fishery agencies. Other
>tasks include a check between EWA actions and consistency with CALFED
>programs (e.g., ERP actions) and CALFED goals, although this is probably a
>role for CALFED to best handle itself (or perhaps they need help).
>
>We could probably learn from the USBR's recent efforts to purchase water
>(in terms of process). Should EWA and USBR water purchase efforts be
>integrated? Advantages: efficiency. Disadvantages: baseline issue could
>complicate linkage between funding and function of water purchase (in-Delta
>AFRP, ERP, EWA) or burden CALFED progress. Do we need to address
>consolidated place of use issues if EWA water is stored in SWP reservoirs?
>
>What is written above is not comprehensive, I'm sure, but it is a start.
>
>Legal and governance issues:
>
>There is no doubt that this area is part of the implementation barrier
>horizon. We could take on a lot in this area if we're not careful.
>Again, I think the methodology could be one of beginning from the EWA
>elements and working outward to implementation while identifying legal
>roadblocks. This approach isn't elegant, but its practical and I think it
>is distinct from other work within CALFED which is refining the
>legal/governance framework. What do you think? The DNCT has already
>identified a few issues, like the reliability of existing legal mechanisms
>to assure the intended use of EWA water released for in-stream purchases,
>but we surely haven't been comprehensive. If this area gets to be
>complicated and enormous feel free to spin off a sub-group.
>
>There may also be financial issues, right? Even if we knew where the money
>was coming from, would there be stumbling blocks for Fed/State/water-user
>money being used for EWA purposes?
>
>Relationship to CALFED workgroups:
>
>I do not know of work by CALFED being conducted with respect to the
>implementation issues. My guess is that CALFED's legal focus has been on
>the comprehensiveness of the revised EIS/R and CEQA/NEPA. That is,

>programmatic level issues have been the focus without enough detail at
>project specific ones. On the grand-integration-for-Stage 1 scale, I do
>not think much work has been completed by CALFED. Mark Cowin is the one to
>ask, though.
>
>Membership:
>
>Earlier in the year we identified the following group members: Dave
>Briggs, Mark Cowin (CALFED), Terry Erlewine (SWC), Dave Fullerton, Karl
>Halupka (NMFS), Cynthia Koehler, BJ Miller, and Nick Wilcox (SWRCB). We
>can certainly adjust the group as needed. I know we already have
>additions.
>
>
>

Cynthia Koehler
Save The Bay
1600 Broadway, Suite 300
Oakland, CA 94612
415/626-6255 (home office tel)
415/626-1029 (home office fax)

# Issues

From: "Rhoads,Peter" <prhoads@mwd.dst.ca.us>
To: fishteam@water.ca.gov
Subject: RE: Issues
Date: Fri, 18 Jun 1999 11:48:05 -0700
X-Mailer: Internet Mail Service (5.5.2448.0)

Pete- You made several statements in your "Issues" email of 6-17 which warrant comment, even though I want to study your hypotheses further and hope to respond to at greater length.

You stated: "Another issue is that the EWA was initiated as a way of enhancing in-Delta protections, as an alternative to further prescriptive standards. We have been implementing it in that spirit, while seeking collateral upstream benefits. In contrast, my perception is the justification for ERP water is driven by upstream needs. AFRP actions are directed towards a mixture of in-stream and Delta purposes. Management of all three needs to be integrated, and we have not attempted that in EWA gaming."

I strongly agree with this and believe that will be substantial synergy through this integration. We need to identify this for the policy people as a high priority task.

"One thing we need to guard against in such integration is that the driving force behind EWA is avoiding additional prescriptive standards, whereas there are legitimate uses of additional prescriptive standards and the ERP water and AFRP are directed largely towards prescriptive standards. I favor keeping EWA's context as facilitating flexible actions primarily to augment benefits from in-Delta prescriptive standards, and the draft hypotheses are proposed in that context."

With due respect, I believe that we are pursuing the EWA because it is a more effective and efficient way of using water for environmental benefits. Because of the variability of fish spatial and temporal distribution in the Delta, the EWA can do a better job, for a given quantity of water, of meeting fish needs. I am completely unconvinced that conventional prescriptive standards can do as well as the EWA for the same amount of water, primarily because of the inter-annual variability of fish dynamics. Am I missing something here?

-----Original Message-----
From: Pete/Lydia Chadwick
Sent: Thursday, June 17, 1999 9:42 PM
To: fishteam@water.ca.gov
Subject: Issues

Folks,

I came away from Tuesday's meeting with an interpretation different than that indicated in the minutes. Basically I made an attempt to define hypotheses underlying the use of EWA water. That is quite different from boiling the issues Ropn distributed down to the top ten.

My draft is attached for your consideration.

You can see that I have tried to simply state the major things we were trying to achieve in making decisions in the gaming exercise. I am somewhat uncomfortable with this approach, because I would hope that actual implementation of an EWA would consider a broader set of biological objectives. Specifically, we triggered essentialy all actions based on minimizing entrainment effects, while considering possibilities for collateral benefits. I would hope that more consideration would be given to Delta outflow related needs in actual implementation.

Another issue is that the EWA was initiated as a way of enhancing in-Delta protections, as an alternative to further prescriptive standards. We have been implementing it in that spirit, while seeking collateral upstream benefits. In contrast, my perception is the justification for ERP water is driven by upstream needs. AFRP actions are directed towards a mixture of instream and Delta purposes. Management of all three needs to be integrated, and we have not attempted that in EWA gaming. One thing we need to guard against in such integration is that the driving force behind EWA is avoiding additional perscriptive standards, whereas there are legitimate uses of additional prescriptive standards and the ERP water and AFRP are directed largely towards prescriptive standards. I favor keeping EWA's context as facilitating flexible actions primarily to augment benefits from in-Delta prescriptive standards, and the draft hypotheses are proposed in that context.

Pete

Date: Thu, 17 Jun 1999 21:42:20 -0700
X-Sender: chadwick@207.212.101.2
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To: fishteam@water.ca.gov
From: Pete/Lydia Chadwick <chadwick@sonnet.com>
Subject: Issues

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I came away from Tuesday's meeting with an interpretation different than that indicated in the minutes. Basically I made an attempt to define hypotheses underlying the use of EWA water. That is quite different from boiling the issues Ropn distributed down to the top ten.

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Pete

HYPOTHES.WPD

* * * * * * *
* Pete and Lydia Chadwick *





D-016290

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* * * * * * *

## HYPOTHESES UNDERLYING THE USE OF AN EWA

The following are the principal hypotheses underlying the use of the Environmental Water Account (EWA):

1. Shifting exports by the CVP and SWP from the time of peak entrainment of chinook salmon, delta smelt and splittail to times when fewer of those species are entrained improves overall survival. Such shifts can increase the abundance of those populations significantly. The benefits of shifting exports are determined by the magnitude of entrainment of the various species, and a number of other considerations, including:

- The overall abundance of the species, with benefits being inversely related to population abundance.
- The age of the fish being entrained, with benefits increasing with age.
- For chinook salmon, the abundance of each race.

2. The benefits derived from shifting exports can often be increased if reductions in exports can be accompanied by shifting the water which is not exported into storage in upstream reservoirs and designating it as part of the EWA account. Such additional storage benefits fish by enhancing temperature control and augmenting instream flows when they are most beneficial to fish.

3. Additional upstream temperature and flow benefits should be sought in managing EWA water purchased upstream of the Delta.

4. Shifting of exports away from times of peak abundance when the Delta is not in balance increases Delta Outflow. That often benefits fish populations indirectly by by creating conditions more favorable for survival.

5. Closing the Delta Cross Channel gates whenever significant numbers of young chinook salmon are migrating past the intake will significantly improve the survival of those salmon.

Date: Thu, 3 Jun 1999 14:47:32 -0700
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X-Mailer: Windows Eudora Light Version 1.5.2
To: fishteam@water.ca.gov
From: Pete/Lydia Chadwick <chadwick@sonnet.com>
Subject: Hypotheses

Folks,

A couple of weeks ago we agreed to have Ron and Tom pull together information already in the record applicable to hypotheses and questions underlying the DEFT exercise. They did that and circulated a draft. Our charge was to look at the draft and make suggestions to see if we could approach a concensus by exchanging editing suggestions.

I have spent some time in the last day reading and thinking about the distributed material. At a few places in the draft, I have inserted comments and observations. (See capitalized sections in the attached draft.) At best, my comments have some limited value in moving us along. My overall reaction is we are not going to get a satisfactory product by sharing editorial suggestions. Further, if we are to consider all of the questions included in the draft, the task is enormous. The initial categorization included in the draft is helpful, but it is only a start at a logical framework, and the questions themselves need a lot of work.

I can not do better than to suggest that Ron get a few of us together to see if we can come up with a workable approach.

Pete

TECHTEAM.DOC

* * * * * * *

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* * * * * * *

Technical Issues/Questions for Tech Team Evaluation by Category:

## 1. Fish and Flow

1.1. Winter export of small flow pulses in dry years (e.g., February 1991) – potential effect of moving X2 upstream and making delta smelt adults more vulnerable to export related impacts.
1.2. Importance of San Joaquin attraction flows – puts demands on SJ storage and is expensive.
1.3. Importance of pulse flows for fish migration and habitat.
1.4. Are there any potential impacts of altering Sacramento River flow in August and September?
1.5. Would changes in Delta inflows and export rates affect upstream habitat conditions?
1.6. X2 standard is a seasonal standard – how do short term changes in flow and X2 potentially affect fish and fish habitat?
1.7. AFRP action sets July exports as a function of June exports – if we adjust June exports, how will we deal with July exports to provide the same or more protection to the striped bass for which the AFRP action is directed?
1.8. Can fish be safely protected by managing X2, QWEST, and other Delta hydrodynamic parameters on a seasonal or monthly basis, or does it require daily management? Is recent hydrodynamic history important? Are other factors (e.g. local velocity fields, water residence time and local habitat conditions) important factors?

## 2. Fish Population Effects and Factors that Affect Them

*2.1.* Effect of export losses on fish populations: At what salvage level is the potential risk to populations significant enough to warrant cutback in exports? "*The team differs on the potential degree of population effects of entrainment and salvage related losses. The team does not agree on the importance of export related effects (direct or in-direct) in reducing these losses on populations.*"
*2.2.* Effect on Sacramento salmon populations. "*The DEFT salmon team differs on the potential degree of recovery that may be achieved from the actions in the Common Program and the AFRP. The team agreed on a list of habitat actions for Stage 1 and on the priorities for the actions. The team agreed that Common Program and Upstream AFRP actions would probably lead to recovery of Sacramento salmon and steelhead populations.*" MY RECOLLECTION IS THAT THE TEAM AGREED THAT UPSTREAM ACTIONS WOULD PROVIDE UPSTREAM CONDITIONS SUFFICIENT TO SUPPORT RECOVERY, RATHER THAN AS STATED HERE WHICH IMPLIES THAT UPSTREAM ACTIONS ALONE WOULD BRING ABOUT RECOVERY.
2.3. Which populations are in greatest need of protection from project operations?
2.4. Is the percent reduction in salvage using the salvage model a real parameter for assessing impacts and benefits of simulations on the populations?

2.5. Do impacts have to be observed or predicted (manifested) at the population level to be significant?

*2.6.* Habitat: "*Salmon stocks can be greatly enhanced over existing conditions by improving habitat, food web, and predator/prey relationships within the interior Delta. We should do every thing possible to reduce movement of juvenile salmon into the interior Delta via the DCC, Georgiana Slough, and HOR.*" THE TWO SENTENCES DO NOT COMPLEMENT EACH OTHER. ALSO THE HOR WOULD NOT REDUCE MOVEMENT INTO THE INTERIOR DELTA.

*2.7.* Ocean Conditions*: Recovery of salmon and other species may be dependent on ocean conditions. For example: the El Nino appears to affect ocean productivity and the distribution of predators and prey of salmon in coastal and open ocean feeding areas of salmon. The team differs on the potential role ocean conditions may be playing in the decline and recoveries of these fish species.* I SUSPECT WE CAN ALL AGREE THAT ANNUAL VARIATIONS IN OCEAN CONDITIONS CAUSE WIDE VARIATIONS IN ADULT ABUNDANCE AND SOMETIMES ARE A MAJOR REASON FOR LOW ADULT SPAWNING ESCAPEMENT. FOR RECOVERY TO "BE DEPENDENT ON OCEAN CONDITIONS", HOWEVER, REQUIRES OCEAN CONDITIONS EITHER TO FREQUENTLY BE SO BAD AS TO THREATEN SPECIES SURVIVAL OR TO BE TRENDING DOWNHILL. DOES ANYONE IN THE GROUP BELIEVE EITHER TO BE THE CASE?

*2.8.* Harvest/Hatcheries*: Recovery potential for salmon, steelhead, and striped bass may depend on activities outside the control of water projects such as harvest in the ocean or hatchery practices. The team differs in the potential role hatcheries and harvest play in the decline and recoveries of these species.*" "*The salmon team did not want to address hatchery issues when the topic was raised with the work group. CalFed really needs to take a separate look at the hatchery issues.*"

*2.9.* Exotics: "*The Bay/Delta is dominated by non-native species. Some introduced species have substantially altered the functioning of ecosystems they have invaded and the team has limited understanding of the new ecological relationships among species. New species will likely continue to arrive and disrupt the biological communities of the estuary in the future. All data and analyses, therefore, that rely on historical relationships may not accurately predict the future. The almost certain arrival of new species in the future may alter the ability of the estuary to support the three species described above. The team has not evaluated the potential role of exotic species in the potential for recovery of important fish populations. However, for many of the team members this is an important issue.*" "*We probably have a concensus that eliminating Potomocorbula from the estuary would be a good thing, but it can not be done.*" I WONDER HOW FAR APART WE REALLY ARE. COULD WE APROACH CONCENSUS ON SOMETHING LIKE THE FOLLOWING: NEW SPECIES INTRODUCED DURING THE PAST 30 YEARS HAVE ALTERED THE ABILITY OF THE ESTUARY TO SUPPORT SOME OF THE SPECIES ALREADY PRESENT, AND MAY BE MAKING IT MORE DIFFICULT TO RECOVER SOME OF THE TARGET FISH SPECIES. WHILE IT IS



D-016295

TECHNICALLY DIFFICULT TO DEFINE SUCH EFFECTS, ONE OF CMARP'S GOALS SHOULD BE TO DO SO.

*2.10.* Other Delta Diversions: "*The team has not evaluated or considered the relative role of other Delta diversions (primarily agricultural and steam electric generating stations) in the decline or recovery of important fish populations.*"

*2.11.* Predation: "*Striped Bass Predation on Salmon Smolts and Yearlings – This is not on the salmon teams list of issues but it should be. EBMUD Fisheries Biologists recently conducted an electrofishing survey in the lower Mokelumne River from Camanche downstream to the confluence with the Cosumnes River. The river was full of striped bass (live well of the electrofishing boat filled up in fifteen minutes) and they were preying on yearling fall-run chinook salmon FAR downstream of Woodbridge Dam. Jim Buell's scenario mentions predator removal in Clifton Court Forebay. The DEFT work group largely ignored Jim's proposal which may have a tremendous benefit in improving the survival of salmon smolts and yearlings.*"

## 3. Fish and Exports

3.1. Importance of dry year exports on fish populations. Gaming did little to reduce exports in dry years.

3.2. Are large gaming reductions in exports in wet years necessary to protect fish? Is the use of EWA assets in wet years to reduce exports the most effective use of resources? Does this maximize population benefits?

*3.3.* Do exports significantly affect habitat, habitat quality, food availability, migration, and distribution of important fish species?

*3.4.* **Migratory cues**: "*On this issue the controversy does not revolve around the fish using one cue versus the other; the issue for salmon is that during their migration they need to shift from a flow cue which is reliable in upstream areas, to a salinity cue that is reliable in tidally influenced areas. How long does this transition take, and how do the fish behave during the transition are important areas of uncertainty and disagreement. The team differs on the factors that guide or cue migrating fish on their movements through the Delta. Some believe net freshwater flow cues are important for downstream migrating juvenile fish such as smolt salmon. Others believe that tides and salinity gradients are potentially more important.*" "*Out migrants key to flow or salt once in tidal zone and move with mean or tidal flows.*" I THINK THIS GETS OFF WELL IN THE FIRST TWO SENTENCES, BUT THEN GETS OFF TRACK, PARTLY BY IGNORING THE ROLE OF THE EXPORT PUMPS. THERE SEEMS TO BE A GOOD CASE FOR A TRANSITION FROM FLOW BEING THE DOMINANT CUE TO SALINITY OR SOME OTHER TIDAL COMPONENT BEING DOMINANT, WITH UNCERTAINTY ABOUT THE TRANSITION. PRESUMABLY THE LOCATION OF THE TRANSITION VARIES WITH THE MAGNITUE OF FRESHWATER FLOW. THE TRANSITION QUESTION IS FURTHER CONFOUNDED BY THE LOCATION OF THE PUMPS AND VARIATIONS IN THE MAGNITUDE OF PUMPING. AT 8,000 CFS OF PUMPING, IT IS EASY TO BELIEVE THAT A SALMON IN

OLD RIVER NEAR THE PUMPS IS QUEING ON FLOW CAUSED BY THE PUMPS. THAT EFFECT OBVIOUSLY DIMINISHES WITH DISTANCE, BUT AT AN UNCERTAIN RATE. THE SAME ISSUE PERTAINS TO OTHER SPECIES ALSO.

3.5. Do exports pull fish from the San Joaquin into the South Delta that would otherwise continue down San Joaquin to Central and Western Delta? Do they pull fish from the Sacramento River into the Central and South Delta that would otherwise move to the Bay?
3.6. What are risks to fish from expanded Banks high export rates?
3.7. Are export losses of salmon confined to hatchery produced salmon?
3.8. Are export losses more serious when populations are low?
3.9. Are effects greater at intake locations in dead-end channels?
3.10. Could increased export rate cause an increase in fish density at the export pumps?
3.11. What is the risk to Sacramento salmon from exports?
3.12. With new screens and VAMP plus HOR barrier, is there adequate protection for SJ salmon?
3.13. Are export losses of steelhead confined primarily to hatchery fish? (Check this year's and last year's salvage for marked fish; and check timing relative to stocking records and locations.)
3.14. Fish/WQ conflict – Water quality would benefit more from July exports, whereas fish would be better off if we wait to transfer water south until August.
3.15. Are there risks to yearling smelt, salmon, and steelhead at Delta Wetland intakes in winter?
3.16. If we manage exports on a daily basis, is there a potential risk of a QWEST roller coaster effect?
3.17. Experiments in one season may not apply to other seasons.

## 4. Fish Habitat as Mitigation for Exports

*4.1.* Can fish habitat improvements mitigate for or reduce impacts of exports? *"A through-Delta alternative should require improved habitat in the central Delta to slow fish egg/larval dispersal toward pumping plants to allow these life stages to mature, to increase food web interactions, to stimulate fish growth and survival, and to facilitate fish/habitat relationships that might otherwise be adversely affected by changes in tidal hydrodynamics attributable to south Delta exports."* WOULD ANYONE IN THE GROUP SUBSCRIBE TO THE FOLLOWING HYPOTHESIS? HABITAT RESTORATION IN THE CENTRAL DELTA PLANNED WITH THE THROUGH DELTA ALTERNATIVE WILL IMPROVE SURVIVAL OF ALL FISH SPECIES SUFFICIENTLY TO OFFSET FULLY MORTALITY CAUSED BY THE DIRECT AND INDIRECT EFFECTS OF EXPORT PUMPING. IF NOT THAT, HOW FAR ALONG THE CONTINUUM OF NO OFFSETTING TO FULL OFFSETTING IS THE LIKELY OUTCOME?

*4.2.* Will habitat improvements benefit fish populations regardless of changes in exports? *"The team differs in the importance of habitat relative to salvage losses* *in the declines of Bay-Delta fish, and the relative potential benefits of habitat improvement and salvage reductions in the recovery of these fish species. The team agrees on habitat actions and the priority for implementing them in Stage 1." "The salmon team agreed on a list of habitat actions for stage 1 from the ERPP, not the AFRP. The salmon team never received a list of the AFRP priority actions so the priorities were based largely upon the ERPP. The salmon team consequently based their assessments on upstream ERPP actions, not on upstream AFRP actions." "Some team members believe that improving habitat is far more important than reducing salvage losses, while other members believe improvements in both are essential."*

5. **Fish and Facilities**

    5.1. **Closure of Delta Cross Channel:** Does closure of the DCC really benefit Sacramento salmon?
    5.2. **New Screens:** Would construction of screens at south Delta pumping plants reduce losses of fish?
    5.3. **Head of Old River Barrier:** "*A barrier at the head of Old River is a concern as it may aggravate the potential of Sacramento or central and southern Delta fish being drawn to the south Delta pumping plants. The team concluded that such a barrier would be essential for restoring San Joaquin salmon, steelhead, and splittail populations, and that a capacity to variably operate the barrier would limit concerns for delta smelt and other Delta and Sacramento River fish.*
    5.4.

6. **Delta Habitat Conditions and Exports**

    6.1. Does interior Delta have poorer water quality and habitat, and as a consequence have lower probability of survival?
    6.2. Is this due to exports or physical configuration?

7. **Fish Distribution and Abundance**

    7.1. Are salvage data a reasonable surrogate for real-time monitoring of fish distribution and abundance?
    7.2. Would delta smelt distribution likely change with changes in exports and inflows?

8. **Winter Run Chinook Salmon**

    8.1. Is there a risk to winter run salmon from exports?
    8.2. To what extent is that risk reduced by new screen facilities and greater frequency of closure of DCC?
    8.3. Do proposed ERP habitat improvements decrease risk to winter run?
    8.4. What are the indirect risks of exports on winter run?
    8.5. Are Stage 1 risks acceptable? Can risks be adequately minimized through adaptive management?

8.6. What upstream EWA flow actions would benefit winter run?
8.7. What can we expect from ERP for winter run in Stage 1?
8.8. Can we differentiate winter run smolts from other smolts in salvage data?
8.9. Would a shift to higher October to March exports from expanded Banks even if confined to wet years increase risks to winter run?

**9. Spring-Run Chinook Salmon**

9.1. Could late summer and early fall transfers from Yuba storage cause spawning in gravel beds that would later become dewatered?
9.2. How much do spring chinook yearlings depend on the first flow pulse of the water year? How can we protect them from export impacts?

10. **Fall Run Chinook Salmon**

10.1. What are the indirect and direct effects on fall run fry from winter Delta exports?
10.2. Are proposed new screening systems adequate to protect fall run fry?

**11. Steelhead**

11.1. Are salvaged steelhead primarily hatchery fish released in February? Are wild fish vulnerable to export facilities?
11.2. Are new screen systems adequate to protect wild steelhead?

**12. San Joaquin Fall Run Chinook Salmon**

12.1. Does survival of downstream migrating subyearlings in spring improve with closure of HOR barrier? If so how much is the improvement? Does it reduce the need for screens at the south Delta pumping plants? IS THERE ANYONE WHO THINKS THE ANSWER TO THE LAST QUESTION IS YES?
12.2.

**13. Delta smelt**

13.1. Do changing exports and flows change the distribution of delta smelt adult spawners, prespawners, and young?
13.2. Would delta smelt benefit from releasing water to outflow from Bacon Island storage?
13.3. How should potential actions vary from year to year based on population abundance index?
13.4. What are the potential effects relating to larval smelt? Are larval smelt far less important because they are less valuable in terms of adult equivalents?

**14. Splittail**

14.1. Would splittail benefit from HOR barrier?
14.2. Would splittail benefit from SJ flow pulses?
14.3. Would splittail benefit from new screens and JPOD?
14.4. Would these new features adequately protect SJ splittail?

**15. Striped Bass**

15.1. Would new screens and habitat enhance striped bass survival sufficiently to allow proposed changes in system operations under EWA without further jeopardizing population or existing fishery?
15.2. Should striped bass be a factor in operation decisions?

Issues



From: Bjmill@aol.com
Date: Wed, 17 Mar 1999 20:43:05 EST
To: acfowler@scvwd.dst.ca.us, bobker@bay.org, ckoehler@econet.org, fishteam@water.ca.gov, hydrobro@ix.netcom.com, ldflowers@aol.com, jmaher@scvwd.dst.ca.us, NoName@water.ca.gov, vgorre@ewri.com
Subject: biological questions and analyses required to answer
X-Mailer: AOL 3.0.1 for Mac sub 84
X-MIME-Autoconverted: from quoted-printable to 8bit by goldeneye.water.ca.gov id RAA18986

ANSWERING QUESTIONS ABOUT PROPOSED BIOLOGICAL RULES FOR USE OF EWA WATER
March 17, 1999

How does the value of X2 affect the location and entrainment of delta smelt?

Analyses

Graph salvage of delta smelt against X2. Use the average of X2 over the period thought to affect subsequent salvage. For example, graph total delta smelt salvage by week against the average of X2 for the preceding month.

Using Dale Sweetnam's circle plots of delta smelt densities every two weeks, determine, by inspection, the center of mass and the limits of the location of the population of delta smelt, and express this as a distance from the export pumps. Plot this distance against the average X2 for the preceding month.

Under what conditions is direct mortality a significant fraction (that is, enough to have a population level effect) of the population of important fish?

For races of salmon and steelhead, prepare a table of the fraction of smolts entering the Delta that suffer direct mortality at the export pumps. Use the water user biologist methodology to determine direct mortality, provided that methodology is found acceptable (data are already available). Otherwise, use four Pumps data. Consider converting direct mortality to smolt-sized fish (or vice-versa) if this makes a difference.

For delta smelt, prepare two time series. The first would be total weekly salvage, converted to direct mortality. This conversion will require assumptions about screening and predation losses. Make those reasonable assumptions that would tend to produce high estimates of direct mortality. (The water user biologists' methodology did this and the data are available.)

For the second series, using Dale Sweetnam's sequence of surveys of delta smelt, estimate the population represented by the results of each survey. This will also require assumptions. In this case, make reasonable assumptions that would tend to produce a low estimate of population.

Then, prepare a graph of the fractional direct mortality by dividing the second time series by the first. Integrate under this curve for each year to produce an annual, high estimate of the fraction of delta smelt suffering direct mortality at the export pumps.

If this high annual fractional mortality is very low, we can be reasonably certain that direct mortality is not having population effects. If it is not very low, consider refining the method.

How does San Joaquin River flow affect the survival of outmigrating smolts?

How does export rate affect the survival of outmigrating San Joaquin River smolts?

Using all applicable data from coded wire tagged releases, run a multiple regression of smolt survival or survival index against flow and exports, choosing appropriate averaging periods.

What are the benefits of closing the Delta Cross Channel gates?

Examine results of the Newman-Rice analysis to check its applicability to different runs. this analysis shows significant benefits to outmigrating smolt survival from closing the gates.

How are the location, entrainment, and survival of important fish affected by QWEST?

For delta smelt, using the center of mass determinations from above, graph the center of mass against QWEST averaged over, say, the preceding month. Also, graph the fractional direct mortality of delta smelt against QWEST averaged over, say, the preceding month.

For salmon, review the latest FWS data on survival vs QWEST. Also, graph the fraction of outmigrating smolts suffering direct mortality against the value of QWEST averaged over, say, the preceding month.

What effect does installing a barrier at the head of Old River have on the entrainment of important fish and the survival of outmigrating San Joaquin River salmon smolts?

Re-do the analysis above for the effect of exports and river flow with and without the barrier.





D-016302

Issues

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ISSUES

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1.2. Importance of San Joaquin attraction flows – puts demands on SJ storage and is expensive.
1.3. Importance of pulse flows for fish migration and habitat.
1.4. Are there any potential impacts of altering Sacramento River flow in August and September?
1.5. Would changes in Delta inflows and export rates affect upstream habitat conditions?
1.6. X2 standard is a seasonal standard – how do short term changes in flow and X2 potentially affect fish and fish habitat?
1.7. AFRP action sets July exports as a function of June exports – if we adjust June exports, how will we deal with July exports to provide the same or more protection to the striped bass for which the AFRP action is directed?
1.8. Can fish be safely protected by managing X2, QWEST, and other Delta hydrodynamic parameters on a seasonal or monthly basis, or does it require daily management? Is recent hydrodynamic history important? Are other factors (e.g. local velocity fields, water residence time and local habitat conditions) important factors?

**2. Fish Population Effects and Factors that Affect Them**

*2.1.* Effect of export losses on fish populations: At what salvage level is the potential risk to populations significant enough to warrant cutback in exports? "*The team differs on the potential degree of population effects of entrainment and salvage related losses. The team does not agree on the importance of export related effects (direct or in-direct) in reducing these losses on populations.*"
*2.2.* Effect on Sacramento salmon populations. "*The DEFT salmon team differs on the potential degree of recovery that may be achieved from the actions in the Common Program and the AFRP. The team agreed on a list of habitat actions for Stage 1 and on the priorities for the actions. The team agreed that Common Program and Upstream AFRP actions would probably lead to recovery of Sacramento salmon and steelhead populations.*"
2.3. Which populations are in greatest need of protection from project operations?
2.4. Is the percent reduction in salvage using the salvage model a real parameter for assessing impacts and benefits of simulations on the populations?
2.5. Do impacts have to be observed or predicted (manifested) at the population level to be significant?
*2.6.* Habitat: "*Salmon stocks can be greatly enhanced over existing conditions by improving habitat, food web, and predator/prey relationships within the interior*

*Delta. We should do every thing possible to reduce movement of juvenile salmon into the interior Delta via the DCC, Georgiana Slough, and HOR."*

2.7. Ocean Conditions: *Recovery of salmon and other species may be dependent on ocean conditions. For example: the El Nino appears to affect ocean productivity and the distribution of predators and prey of salmon in coastal and open ocean feeding areas of salmon. The team differs on the potential role ocean conditions may be playing in the decline and recoveries of these fish species.*

2.8. Harvest/Hatcheries: *Recovery potential for salmon, steelhead, and striped bass may depend on activities outside the control of water projects such as harvest in the ocean or hatchery practices. The team differs in the potential role hatcheries and harvest play in the decline and recoveries of these species." "The salmon team did not want to address hatchery issues when the topic was raised with the work group. CalFed really needs to take a separate look at the hatchery issues."*

2.9. Exotics: *"The Bay/Delta is dominated by non-native species. Some introduced species have substantially altered the functioning of ecosystems they have invaded and the team has limited understanding of the new ecological relationships among species. New species will likely continue to arrive and disrupt the biological communities of the estuary in the future. All data and analyses, therefore, that rely on historical relationships may not accurately predict the future. The almost certain arrival of new species in the future may alter the ability of the estuary to support the three species described above. The team has not evaluated the potential role of exotic species in the potential for recovery of important fish populations. However, for many of the team members this is an important issue." "We probably have a concensus that eliminating Potomocorbula from the estuary would be a good thing, but it can not be done."*

2.10. Other Delta Diversions: *"The team has not evaluated or considered the relative role of other Delta diversions (primarily agricultural and steam electric generating stations) in the decline or recovery of important fish populations."*

2.11. Predation: *"Striped Bass Predation on Salmon Smolts and Yearlings – This is not on the salmon teams list of issues but it should be. EBMUD Fisheries Biologists recently conducted an electrofishing survey in the lower Mokelumne River from Camanche downstream to the confluence with the Cosumnes River. The river was full of striped bass (live well of the electrofishing boat filled up in fifteen minutes) and they were preying on yearling fall-run chinook salmon FAR downstream of Woodbridge Dam. Jim Buell's scenario mentions predator removal in Clifton Court Forebay. The DEFT work group largely ignored Jim's proposal which may have a tremendous benefit in improving the survival of salmon smolts and yearlings."*

## 3. Fish and Exports

3.1. Importance of dry year exports on fish populations. Gaming did little to reduce exports in dry years.

3.2. Are large gaming reductions in exports in wet years necessary to protect fish? Is the use of EWA assets in wet years to reduce exports the most effective use of resources? Does this maximize population benefits?

3.3. Do exports significantly affect habitat, habitat quality, food availability, migration, and distribution of important fish species?

3.4. **Migratory cues**: "*On this issue the controversy does not revolve around the fish using one cue versus the other; the issue for salmon is that during their migration they need to shift from a flow cue which is reliable in upstream areas, to a salinity cue that is reliable in tidally influenced areas. How long does this transition take, and how do the fish behave during the transition are important areas of uncertainty and disagreement. The team differs on the factors that guide or cue migrating fish on their movements through the Delta. Some believe net freshwater flow cues are important for downstream migrating juvenile fish such as smolt salmon. Others believe that tides and salinity gradients are potentially more important.*" "*Out migrants key to flow or salt once in tidal zone and move with mean or tidal flows.*"

3.5. Do exports pull fish from the San Joaquin into the South Delta that would otherwise continue down San Joaquin to Central and Western Delta? Do they pull fish from the Sacramento River into the Central and South Delta that would otherwise move to the Bay?

3.6. What are risks to fish from expanded Banks high export rates?

3.7. Are export losses of salmon confined to hatchery produced salmon?

3.8. Are export losses more serious when populations are low?

3.9. Are effects greater at intake locations in dead-end channels?

3.10. Could increased export rate cause an increase in fish density at the export pumps?

3.11. What is the risk to Sacramento salmon from exports?

3.12. With new screens and VAMP plus HOR barrier, is there adequate protection for SJ salmon?

3.13. Are export losses of steelhead confined primarily to hatchery fish? (Check this year's and last year's salvage for marked fish; and check timing relative to stocking records and locations.)

3.14. Fish/WQ conflict – Water quality would benefit more from July exports, whereas fish would be better off if we wait to transfer water south until August.

3.15. Are there risks to yearling smelt, salmon, and steelhead at Delta Wetland intakes in winter?

3.16. If we manage exports on a daily basis, is there a potential risk of a QWEST roller coaster effect?

3.17. Experiments in one season may not apply to other seasons.

## 4. Fish Habitat as Mitigation for Exports

4.1. Can fish habitat improvements mitigate for or reduce impacts of exports? "*A through-Delta alternative should require improved habitat in the central Delta to slow fish egg/larval dispersal toward pumping plants to allow these life stages to mature, to increase food web interactions, to stimulate fish growth and survival, and to facilitate fish/habitat relationships that might otherwise be adversely affected by changes in tidal hydrodynamics attributable to south Delta exports.*"

4.2. Will habitat improvements benefit fish populations regardless of changes in exports? *"The team differs in the importance of habitat relative to salvage losses in the declines of Bay-Delta fish, and the relative potential benefits of habitat improvement and salvage reductions in the recovery of these fish species. The team agrees on habitat actions and the priority for implementing them in Stage 1." "The salmon team agreed on a list of habitat actions for stage 1 from the ERPP, not the AFRP. The salmon team never received a list of the AFRP priority actions so the priorities were based largely upon the ERPP. The salmon team consequently based their assessments on upstream ERPP actions, not on upstream AFRP actions." "Some team members believe that improving habitat is far more important than reducing salvage losses, while other members believe improvements in both are essential."*

5. **Fish and Facilities**

5.1. **Closure of Delta Cross Channel:** Does closure of the DCC really benefit Sacramento salmon?

5.2. **New Screens:** Would construction of screens at south Delta pumping plants reduce losses of fish?

5.3. **Hood ~~Diversion:~~** *"There were three primary issues relating to such a diversion: (1) the potential diversion of fish eggs and larvae from the Sacramento River into the interior Delta where they would be susceptible to poor water quality and habitat, and increased probability of being drawn to the export facilities in the south Delta; (2) the potential adverse effects of employing a screen at the diversion in blocking upstream migrating adult and potentially damaging downstream migrating juvenile Sacramento salmon, steelhead, striped bass, and other fish; and (3) the potential adverse effects of a reduction in net downstream freshwater flow in the Sacramento channel below the Hood diversion. Most of the team agreed that the positive effects of a diversion (i.e., improved Delta flow patters, improved interior Delta and export water quality, and a reduction in the proportion of San Joaquin River outflow exported) outweighed the negative effects of a Sacramento diversion to the interior Delta and lower flows in the lower Sacramento River channel below the diversion, especially when the DCC is closed. The team concurred that the proposed small (2,000 cfs) facility was sufficient to test the application of such a facility. Screening the intake of a diversion facility was deemed necessary, otherwise there would be little advantage over the existing Delta Cross Channel at Walnut Grove, which would be closed to protect Sacramento fish."*

5.4. **Head of Old River Barrier:** *"A barrier at the head of Old River is a concern as it may aggravate the potential of Sacramento or central and southern Delta fish being drawn to the south Delta pumping plants. The team concluded that such a barrier would be essential for restoring San Joaquin salmon, steelhead, and splittail populations, and that a capacity to variably operate the barrier would limit concerns for delta smelt and other Delta and Sacramento River fish.*

5.5. **South ~~Delta Barriers of ISDP:~~** *"South Delta barriers of the Interim South Delta Program (ISDP) have not been recommended by DEFT as they may* *increase vulnerability of fish to south Delta export pumps. However, the team recognizes that the barriers or equivalent measurers may be necessary to provide the necessary operational flexibility to expand water supplies for environmental resources."*

**6. Delta Habitat Conditions and Exports**

6.1. Does interior Delta have poorer water quality and habitat, and as a consequence have lower probability of survival?
6.2. Is this due to exports or physical configuration?

**7. Fish Distribution and Abundance**

7.1. Are salvage data a reasonable surrogate for real-time monitoring of fish distribution and abundance?
7.2. Would delta smelt distribution likely change with changes in exports and inflows?

**8. Winter Run Chinook Salmon**

8.1. Is there a risk to winter run salmon from exports?
8.2. To what extent is that risk reduced by new screen facilities and greater frequency of closure of DCC?
8.3. Do proposed ERP habitat improvements decrease risk to winter run?
8.4. What are the indirect risks of exports on winter run?
8.5. Are Stage 1 risks acceptable? Can risks be adequately minimized through adaptive management?
8.6. What upstream EWA flow actions would benefit winter run?
8.7. What can we expect from ERP for winter run in Stage 1?
8.8. Can we differentiate winter run smolts from other smolts in salvage data?
8.9. Would a shift to higher October to March exports from expanded Banks even if confined to wet years increase risks to winter run?

**9. Spring-Run Chinook Salmon**

9.1. Could late summer and early fall transfers from Yuba storage cause spawning in gravel beds that would later become dewatered?
9.2. How much do spring chinook yearlings depend on the first flow pulse of the water year? How can we protect them from export impacts?

**10. Fall Run Chinook Salmon**

10.1. What are the indirect and direct effects on fall run fry from winter Delta exports?
10.2. Are proposed new screening systems adequate to protect fall run fry?

**11. Steelhead**

11.1. Are salvaged steelhead primarily hatchery fish released in February? Are wild fish vulnerable to export facilities?
11.2. Are new screen systems adequate to protect wild steelhead?

**12. San Joaquin Fall Run Chinook Salmon**

12.1. Does survival of downstream migrating subyearlings in spring improve with closure of HOR barrier? If so how much is the improvement? Does it reduce the need for screens at the south Delta pumping plants?

**13. Delta smelt**

13.1. Do changing exports and flows change the distribution of delta smelt adult spawners, prespawners, and young?
13.2. Would delta smelt benefit from releasing water to outflow from Bacon Island storage?
13.3. How should potential actions vary from year to year based on population abundance index?
13.4. What are the potential effects relating to larval smelt? Are larval smelt far less important because they are less valuable in terms of adult equivalents?

**14. Splittail**

14.1. Would splittail benefit from HOR barrier?
14.2. Would splittail benefit from SJ flow pulses?
14.3. Would splittail benefit from new screens and JPOD?
14.4. Would these new features adequately protect SJ splittail?

**15. Striped Bass**

15.1. Would new screens and habitat enhance striped bass survival sufficiently to allow proposed changes in system operations under EWA without further jeopardizing population or existing fishery?
15.2. Should striped bass be a factor in operation decisions?

Fullerton

EWA

Prerequisites to a Working EWA
David Fullerton
June 7, 1999 Draft

Here are some thoughts on what we will need to put in place in order to have a fully functional EWA. We might be able to get by on less initially. However, in the long-run, we will need to put the EWA on a firm legal footing if we expect to rely on it as a major part of the CALFED solution.

**Functions**

What will the EWA actually do. Based on these functions, we can then project institutional needs. As always with such lists, we can argue about what topics are core functions and which are the institutional implications of other core functions. I have tried to be inclusive and not quibble over categories.

- Analyze biological monitoring data. This will provide the foundation for real time management activities.
- Control some biological monitoring. Depending on real time conditions, the EWA may wish to focus monitoring efforts in order to develop information needed for operations. It will not be able to rely exclusively upon monitoring conducted by other agencies. This has implications for the EWA's role in CMARP. It may be possible to separate monitoring from operations. However, at the least we must create some mechanism by which the EWA can be assured of getting its monitoring needs met.
- Modify State and Federal Project operations on a virtually real-time basis, as constrained by the "no harm" principle and regulations. This includes:
    - Modify south Delta export rates (up and down)
    - Modify reservoir release rates (up and down)
    - Shift pumping between the Tracy and Banks pumping plants.
    - Use surplus storage, pumping, and conveyance capacity
- Reimburse the Projects for net expenses caused by EWA activities.
- Purchase and lease water. Buy options for water. Purchase and lease storage. Purchase and lease conveyance capacity. Sell and lease all of the same.
- Gain approval for variances to certain regulatory standards on a virtually real-time basis. The most obvious example is the E/I standard. However, variance might also be needed for AFRP standards and other standards.
- Acquire a legal right to control water and infrastructure designated for the EWA. This includes (properly qualified) rights to:
    - capture and hold water in Project storage.
    - divert water using Project facilities.
    - utilize unused Project capacity.
    - provide flows above regulatory minima.
    - purchase and sell water.
    - purchase and sell storage and conveyance rights in non Project facilities.
- Use EWA assets in order to promote well-defined biological priorities. These priorities will include both normal operations based upon best available science <u>and</u> operations to support scientific experimentation.
- The EWA may have some rights to define biological priorities. However, these rights may also reside in other institutions as well (e.g., the regulatory agencies).
- Perform environmental review for proposed activities.
- Subordinate EWA activities to overall ERP priorities

- Subordinate EWA activities to ESA priorities

  These two subordinations are not easy to reconcile. The ERP calls for actions to support overall ecosystem function. The ESA calls for protection of individual species, even at the expense of overall ecosystem function. To a large extent, EWA priorities are likely to be determined by the degree to which the EWA becomes the foundation of a "no surprises" commitment from the regulatory agencies. If the EWA carries the primary responsibility providing ESA protection, then the EWA will necessarily give a high priority to protection of listed species. Moreover, EWA assets will tend to be locked into place. If the EWA is more an enhancement agency, but responsibility for ESA protection continues to fall upon the Projects, then EWA priorities will become more balanced and EWA assets could more easily be shifted out of the EWA and into other ERP activities. For example, if habitat were determined to provide greater payoffs per dollar spent, some EWA assets might be sold and the proceeds used to fund additional habitat creation.

**Carrying out the functions**

These functions constrain the form of the EWA. Nevertheless, a number of institutional approaches may be able to satisfy these functions. Here are some initial thoughts:

- The need for near real-time activity – direction and analysis of monitoring, and operational decisionmaking – imply that day to day EWA operations should be integrated. Individual EWA operational decisions should not require and preapproval from multiple agencies.
- However, overall governance of the EWA – the setting of priorities, the approval of experiments, feedback on past operations, etc. – need not be completely integrated.
- The greater the weight placed upon the EWA to deal with operational ESA issues, the greater the control that the regulatory agencies will have over EWA governance. The agencies might control the EWA directly. Alternatively, the EWA could be made responsible for meeting ESA operational patterns on behalf of the Projects. In this case, the regulatory agencies would or could control the EWA indirectly through their biological opinions (of course, if this approach eliminated EWA flexibility, then it would also destroy the benefits of shifting to an EWA in the first place).
- Many EWA activities could be nested within the existing State and Federal Projects. That is, many EWA activities could be structured through contracts with the Projects, without the need to obtain independent EWA rights. This is so because the Projects already have the flexibility to perform many EWA actions, but have no incentive to do so because of increased cost, loss of supplies, and risk to contractors. The following functions could be satisfied through contracts with the Projects:

  - Reductions and increases in export rates.
  - Reductions and increases in releases from storage
  - EWA access to surplus storage and conveyance.
  - EWA rights to a share of new Project storage and pumping capacity.
  - A methodology for keeping track of EWA water and debts within the state and federal Projects.

- Other EWA activities functions could be carried out through contracts with other water agencies:

  - Demand shifting would require a contract with MWD
  - Water and storage purchases in involving non Project agencies.

- Some EWA functions would require regulatory action. For example:

  - If EWA is to have the right to relax the Delta export standards in order to build up water south of the Delta, then the SWRCB would need to delegate to the EWA the right to propose variances, subject to approval or veto by the SWRCB (a right the SWRCB has already granted to the Operations Group).

- EWA control over in-stream flows might be obtained through an environmental water right. That is, existing regulatory minima, as well as uncontrolled flows might be converted into a tradeable water right held by the EWA. This water would then become off limits to reallocation or future development, except with the permission of the EWA.
- EWA enhancements in flow conditions above existing conditions or rights might be secured through environmental water transfers (e.g., under Section 1707) such transfers would need both the approval of the seller and the SWRCB.

- If EWA is a key part of some grant of "regulatory certainty, then funding for EWA must be very firm. The regulatory certainty can be no more certain than EWA funding.
- Similarly, ordinary EWA operations would be severely hampered by an insecure funding stream. The EWA would not be able to take on storage debt. Nor could it purchase options unless it had certainty that future money would be available pay off debts and to take advantage of option contracts.

**What is needed to have a working EWA by the end of the year 2000?**

Inasmuch as the State and Federal Projects already have the authority to perform many of the functions proposed for the EWA, setting up an ad hoc structure should not be particularly difficult, provided that we begin now. A more official structure could take longer. The following would allow the EWA to begin operations as early as water year 2000 on a crude basis, with more extensive operations by the year 2001.

- Gain commitments from the State and Federal Projects to operate in support of the ad hoc EWA, provided that the operations do not harm their contractors.
- Dedicate funding to the EWA.
- Negotiate contract to gain access to Kern Water Bank, probably using SWP or SWP contractor as proxy
- Call existing USBR water purchase options in 1999 for EWA and place into storage (either south of the Delta in Kern water bank, or San Luis Reservoir, or back up into Shasta Reservoir)
- Contract for additional water purchases in year 2000.
- Search for opportunities to generate additional EWA water during 1999 and 2000 using E/I relaxations granted by SWRCB WQCP.

EWA Issues Paper
June 7, 1999
David Fullerton

Some points to consider as we write our reports and define future games, listed in no particular order.

**Limited Time Series**

We have only looked at a single 5 year sequence. That sequence began with 2 critical years (following several additional dry years). In 1993 (a wet year), fish stocks were at very low levels due to the drought and required an unusual amount of protection. Perhaps only 1994 and 1995 could be considered relatively typical. Thus, our conclusions are based upon a very shaky foundation. *I recommend that we move to a longer gaming sequence, once we have worked out some additional kinks in our gaming method (see below).* Beyond that, we could look at randomizing our hydro or biological data, but I think that we can wait on that for a while.

**Improvements in Daily Sim Model**

The daily simulation model is an extremely useful tool. However, the model has several limitations that appear to be relatively easy to fix (there may be others):

- Annual deliveries. The model attempts to export water at very high rates, even in years in which historical demand did not exist for that water. This feature is a useful reminder that, under the present rules, exports could increase dramatically during wet years. However, when looking at near-current conditions, the high deliveries in the model force the EWA to buy down phantom exports. This phenomenon exaggerates the difficulty in making the EWA work.
- Accounting. The model does not perform a very thorough accounting of operations. This can lead to distortions and forces us to keep a separate tally of EWA and Project actions. We may decide that including the accounting within the model is not worth the effort. However, for the record, here are the kinds of things that appear to be left out:
  - EWA water is not tracked separately in the model. We need to have a tally of EWA storage in every reservoir.
  - EWA water in groundwater storage is not tracked within the model.
  - Delta island storage, whether stand-alone or interconnected to the export pumps is not tracked within the model.
  - Storage in San Luis does not reflect south of Delta water purchases by the EWA. Therefore, San Luis storage frequently will drop below actual projected levels. This makes EWA operations appear more harmful to the Projects than they really are and can make it more difficult to fill San Luis the next year than in reality.
  - The model should be able to account for changes in Project deliveries compared to the baseline. There are a number of scenarios in which the Projects will be able to increase Project deliveries compared to the baseline.
- Fish take analysis. Many actions take place during only a portion of a month and target periods of highest (or lowest) fish take. However, the model averages diversions and take over the entire month, thereby minimizing the benefits of real-time management. The model should average and compute fish take by week, not by month. Also, analysis section does not account for changes in the take numbers which were assumed by the biologists. For example, higher flows caused by the EWA were assumed to shift Delta smelt downstream during May? of 1993? Therefore, we assumed that very high take densities of smelt in the historical record would not recur. Therefore, we did not make export reductions. But the model did not make that adjustment and the post game analysis showed enormous take during this month.
- Weekly operations. The model presents information in one month chunks, though we do have the ability to operate on a weekly basis. Unless we are able to digest information and operate routinely on

a weekly or shorter basis, we will not be confronted with the true difficulties the EWA will face in its real-time operations.

- Automate game runs.

**Improving Gaming Efficiency**

Our gaming procedure remains unnecessarily inefficient. When we are only able to game 2-3 years per day, we drastically limit the number of scenarios that we can look at. If we want to be able to run a large number of additional scenarios (including years we have yet to simulate), we may wish to consider some of the following ideas:

- Don't repeat real-time biological analysis each game. As long as we continue to use historic data, then the biological problems and concerns are unlikely to change very much from game to game. If we do the analysis in detail once, we should be able to reuse that analysis each game. The main exceptions will occur when changed antecedent conditions changes our biological assessment (e.g., increased outflow due to EWA in a previous month reduces concern over Delta smelt take).
- Use previous games as a baseline for closely related games. When running games that are closely related, there may be no need to completely rerun the game from scratch. For example, we probably could have run Game 5 as a simple variation on Game 4. EWA assets were the same as Game 4, except that we had an extra $10 million per year and could no longer rely upon the in-Delta AFRP flows. Therefore, instead of working from a DWRSIM base run, we could have used the Game 4 results as our base run and made only those changes necessitated by the change in assets. This would have greatly simplified our job.
- To extend this concept, once we are aware of the biological issues, we should be able to automate much of our games. For example, if we know the months (or weeks) in which we wish to keep pumping down to 5 kcfs and the months (or weeks) in which we are willing to allow E/I variances, then we could program these conditions into the daily model. We would then no longer need to spend time on these measures and could focus on other decisions, such as water purchases, flow releases, etc. We could even change infrastructure and see how our decisions on flow reductions and increases would hold up.
- Post Process closely related games. Similarly, we could have simply analyzed the April – May period of Game 4 in order to estimate the amount of additional resources that would have been required to compensate for the elimination of the in-Delta AFRP flows.

**Opportunity Costs**

One of the consequences of putting an EWA with a limited budget is to force consideration of opportunity costs. That is, the EWA is asked to provide the greatest degree of protection and enhancement possible per dollar invested. In general, the greater the number of opportunities for investing in environmental investment, the greater the return on investment. One major limitation we have imposed upon ourselves in the gaming is to allow EWA assets to be invested only in the acquisition, transportation, and storage of water. For this limited universe of investment opportunities, we can presumably come up with some sort of optimum investment pattern. However, we also need to consider the possible advantages of allowing some interaction between the EWA assets and the ERP Program. If land purchase and restoration is more highly leveraged, dollar for dollar, than the least useful export reductions, then we should be transferring money out of the EWA and into habitat. Similarly, if the export reduction program is paying bigger dividends than habitat, we should shift money the other way.

As an example of how connecting EWA and ERP budgets might cause us to rethink EWA operations, consider the way we treated 1993 during Game 2. In that year, a wet year, we expended on the order of $40 million of EWA assets on export reductions during a period of very high flows. Were the fish saved worth $40 million? Certainly, if the EWA is limited to purchasing water for export reductions. But if EWA can be used to purchase other environmental benefits, then the picture is more cloudy. For this money, the EWA could have purchased 10 –20,000 acres of land in the Delta,[1] or purchased numerous screens, our bought 250,000 acre-feet of water upstream to boost instream flows. Was it still worth it? Maybe so, given that this was the first wet year after a long drought. Maybe not. But the point remains valid, either way. The EWA works best if it is not isolated from other environmental programs, but is treated more as one of many places in which to invest environmental money.

**Wet Year/Dry Year Protection**

Most of us originally believed that the EWA would expend a disproportionate amount of resources in dry years, while accumulating resources during wet years. This was not the case during Game 2 – the end of Stage 1. We actually accumulated assets during the dry years and spent them during the wet years. Why? Most of the environmental actions taken during this game were export reductions during sensitive periods. Since exports were very low during the drought years of 1991 and 1992, the cost of reducing exports was low. Meanwhile, the EWA had a few opportunities to divert water and was able to buy some cheap water. During 1993, the stakes rose by an order of magnitude. The EWA was able to divert more water for itself, but was also forced to spend enormous amounts of water and money to bring down exports from 15 kcfs to a level considered safe by the biologists. The year 1993 may have been an anomaly in that historical stocks were very low so that the biologists felt compelled to protect fish despite relatively low fish densities at the pumps. Nevertheless, it raises fundamental questions about EWA priorities and the distribution of property:

- If environmental protection is mainly a matter of reducing already low export levels in dry years at low cost, but dramatically reducing spring export levels in wetter years (at high cost), then the mismatch in needs between EWA and the Projects provides an opportunity to restructure EWA assets and strategies. For example, EWA might strike a deal with the Projects to supply dry year water to the Projects. In return, the Projects would deliver double or triple that amount of water to EWA in below normal, above normal, and wet years. In this way, EWA can effectively transfer unneeded dry year assets to the wetter years when they are most needed.
- Another way to accomplish this transfer of assets is to give the EWA a larger share of new export capacity, thereby reducing the cost of reducing pumping and allowing the EWA to recoup water debts more readily. This approach is recommended elsewhere in this paper.
- Alternatively, if dry years are the greater problem, then we need to emphasize strategies that transfer wet year assets to the dry years. That means storing up water and building up financial reserves during wet years for use in dry years. Pursuit of this strategy would mean:

    - Accepting somewhat greater levels of take during wet years under the assumption that higher flows will more than compensate for additional take. In this way, we can spend less and accumulate more water.
    - Using more money and more water to enhance flows during dry years
    - Develop as much storage as possible so that storage can be held from wet years to dry years. Long-term EWA storage assets currently are limited to 400 kaf of groundwater storage and 50 kaf of surface storage – not enough to do all that much during a long-term drought. This is probably all that we can look forward to in Stage 1. However, the need for more EWA storage might be incorporated into later stages.
    - Develop risk management strategies. For example: Enter a future's market (if one existed). In this type of market, the EWA would buy an option for water to be delivered the next year at an agreed price (before we know what kind of year it will be). The cost of the option and the cost of the water in the option would incorporate the risks, as seen by the seller. Then, if next year is wet, the option need not be exercised (and the EWA is only out the option cost). If the next year

[1] For example, we might buy Delta islands, picking up the following benefits: habitat, reduced TOC loading, reduced island entrainment, and EWA water (via reduced ET). Of course, the desire to limit conversion of agricultural land may limit the quantity of agricultural land available for conversion to habitat.

is dry, then EWA can exercise its option at a bargain price and the seller is on the hook to provide the water at a loss. We need to look into this in more detail. This type of future market exists in practically all arenas other than water. It would be a valuable tool for the EWA and for other water users as well.

**Synergies**

One of the major advantages of an EWA which controls a network of assets is that such an agency can take advantages of differences in the value of operations in time and space, just the way other water agencies do. For example, when the environmental value of reduced pumping is high, the EWA can reduce exports. When the disvalue of exports is low, then the EWA can increase exports. Indeed, by taking advantage of time and geographic differentials in the value of changed operations, the EWA is able to reuse the same water more than once to provide multiple benefits. Moreover, it can shift resources around to bolster weak points in the system. For example, the EWA could purchase water on the San Joaquin system to improve fall attraction flows, export and trade that water for water in Shasta, then release the water from Shasta (this assumes that the optimal fall flow patterns do not completely coincide on these two rivers) later in the fall, export the water, then sell the water and recoup the original cash investment. If the improvements due to the increased upstream flows outweigh the damage caused by the export of this water, then the EWA was able to generate benefits at a very low cost. In this sense, the EWA might be seen as a very efficient catalyst – able to make shifts in operations that have always been possible, but which do not occur because they cost extra money or increase risk to water users.

Moreover, the EWA managers will have an enormous incentive to improve the sophistication and effectiveness of their network of assets. Very likely, operational opportunities exist which have yet to emerge in the gaming to date.

**EWA Debt and Collateral**

The EWA has the right, in the games, to take on storage debt, provided that it has adequate collateral to assure timely payback to the Projects. This is a very useful tool for the EWA, but we have oversimplified the issue in the gaming.

In Game 2 in 1993, the EWA took on enormous amounts of debt in San Luis in order to curtail pumping during the spring. The debt was paid off before the end of the summer with some groundwater pumping (120 kaf), some extra Delta pumping (?), some south of Delta purchases (100 kaf), and by moving 235 kaf of storage and purchases from north of the Delta to SLR. We even had a few additional tools we could have thrown at the problem. We might have asked for demand shifting from MWD to allow delayed payback. We might have shifted water from Shasta and Oroville etc. into San Luis during July and August (thus moving the debt upstream). We also might have relaxed additional environmental standards (assuming we had the authority to do so) to generate more export water.

Nevertheless, I am sure that the Projects would be very nervous about allowing this kind of a hole to be created in San Luis Reservoir, based upon the kinds of committed by the EWA. What would have happened if the spot purchase had fallen through or someone had protested shifting the EWA water from north of Delta to SLR? What if Kern or Santa Clara had refused the EWA access to groundwater pumping? If things were to go badly, the EWA's payback of SLR water might have been delayed past the SLR lowpoint, in which case contractors would have received reduced deliveries right at the end of the growing season. Thus, I believe, the value of collateral must be discounted to account for possibility that it cannot be delivered in a timely fashion. If the market is unreliable (as is the case now), then a commitment by the EWA to purchase and deliver water by a date certain must be heavily discounted. If the regulatory hoops required to move water from north of Delta to the export areas create uncertainty, then water owned by the EWA upstream must be discounted. This is not to say that EWA should only be allowed to act if it has water sitting in surface storage south of the Delta. But I do assert that the creation of debt by the EWA can proceed only if the EWA can assure the contractors that operations of the EWA will not put them at risk.

This implies that we need to take a second look at the reliability and feasibility of the various EWA tools. The game should be modified to reflect the actual constraints that may govern the various tools. For example:

- Markets. Will a spot market exist that will allow the EWA to purchase water virtually instantaneously? Such markets exist in other resource areas (power, oil, etc.), but are not reliable yet for water in California. What regulatory process will the EWA need to go through for purchased water? Will the process be efficient enough to allow use of the water within a few months of purchase? Can upstream purchases be delivered in a short-term pulse (as was done in July of 1993)? Or must they be delivered over a longer period (e.g., via reduced diversions by local agricultural districts).
- Demand Shifting. Will demand shifting arrangements with MWD be available every year? At what volume?
- Groundwater deposits/ extractions. Will extraction capability exist in all years? When is competition likely to be the highest? Can EWA purchase high priority access to extraction capacity?
- Relaxations. Will the EWA be able to grant E/I relaxations with high certainty, or are they likely to be vetoed by the SWRCB or other regulatory agency? If their ability to grant variances is unreliable, then the EWA cannot rely upon future relaxations to pay off a debt to the Projects.
- Delta storage. Water quality concerns continue to be raised about Delta storage, if these concerns turn out to be valid, the EWA may be more constrained in its use of Delta storage (though I believe this problem can be worked out as discussed below).

These kinds of considerations push us in certain directions, if we believe (as I do) that the ability to contract debt is crucial for the EWA. The common thread is reliability. The EWA must seek high reliability in its water purchases. This implies either purchases from south of the Delta, or long-term agreements. The EWA should also place a high priority on high priority access to storage and storage extraction capability south of the Delta. Thus, for example, the value of groundwater to the EWA may have been underrated thus far, because the reliability value of real water in accessible storage has not been a factor in the games to date.

To the extent that EWA collateral is not firm, it must be discounted. This means that the EWA may not be allowed to take on large debts, or that the EWA may be forced to pay a premium (i.e., greater than 1:1 payback) for borrowing.

**EWA Impact on the Transfer Market**

In practical terms, the EWA will alter reservoir release and export patterns to improve environmental conditions and reduce damage. The ability to grant variances to the E/I ratio actually represents an increase in system flexibility attributable to the EWA (as would the ability to vary other standards). However, in most other respects, the EWA is likely to reduce system flexibility by reducing the remaining discretion available to Project operators and water purchasers to increase pumping. The basic operating tenet of the EWA is "no impacts on the Projects" so the Projects will not be affected by reduced flexibility. However, agencies attempting to move water through the Delta could be impacted by the reduced pumping windows left remaining for moving water through the Delta.

During dry years, pumping capacity remains available, though water transfers may be required to pay transfer taxes of 35% to satisfy the E/I standards. In the wetter years, demands will drop and deliveries rise, reducing the need for water transfers. In middling years, there might be problems. In these years, the Projects will be pumping at relatively high levels during the summer and fall, while the EWA may be moving large amounts of water through the Delta to pay off debts incurred during the spring and to build up storage in San Luis. Additional analysis is needed to determine whether the EWA is likely to constrain the markets. If the EWA is determined to be constraining markets, then a few responses are possible. First, the EWA might be forced to share surplus Project capacity with other water purchasers. Second, the expansion of pumping capacity at Banks will create new flexibility that may eliminate the bottleneck.

**Environmental Constraints and the EWA**

During Game 2, the EWA was somewhat hampered in its ability to fill Delta island storage by environmental regulations. During this game, Delta storage could not be filled on several occasions, despite opportunities and low impacts. But the operating rules for Delta storage were developed under the assumption that the project would develop yield for water users. If, instead, the project is devoted to environmental enhancement and is under the control of environmental managers, the need for very rigid standards may require reconsideration. The same can be said about other environmental constraints which, when imposed upon water projects make good sense, but which could become an unneeded complication for the EWA. In this category might fall the AFRP standards and the X2 standard. I am not saying that these standards should be relaxed, but that we may wish to consider giving the EWA some flexibility to modify these standards in order to improve environmental protection (as we have examined with the E/I relaxations).

**Feedbacks to Deal with Improved Infrastructure and Increased Future Demands**

Gaming to date indicates that the Projects are highly constrained in dry years, but are relatively unconstrained in wet years. Thus, new infrastructure (increased export capacity, storage) will allow some increases in exports during dry years, but major increases in exports during wet years. These increases in exports could lead to increased impacts, unless constrained by regulations or unless the EWA is given enough new resources to compensate.

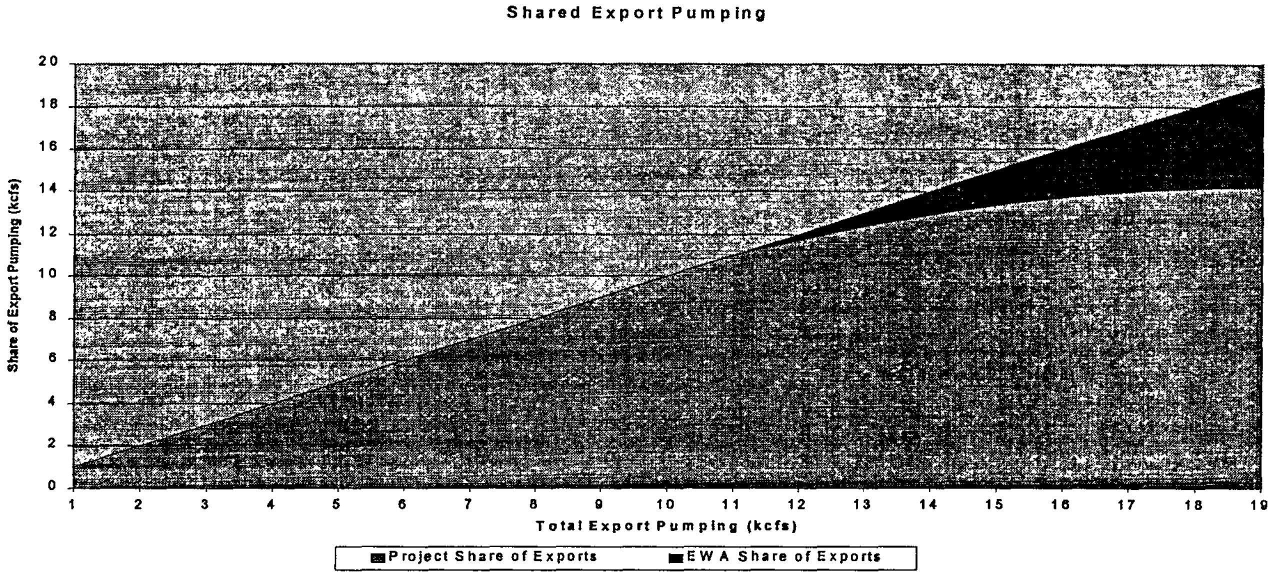
The same is true of future demand. During wet years, Project deliveries are not constrained by infrastructure, but by limited demand. As system demand increases, normal and wet year diversions will also increase, leading to more environmental damage. The CALFED efficiency program may be able to slow the growth in demand. However, for safety, there should be some feedback mechanism to assure that environmental conditions do not deteriorate or time due to increased demands.

I believe that both of these objectives might be satisfied by defining sharing formulas for new export and storage capacity which assure that EWA capacities grow automatically as infrastructure grows and demand grows. One possible function is discussed in the next section.

**Distributing Export Capacity Between EWA and the Projects**

The games to date have demonstrated the utility of export capacity controlled by the EWA. Combined with storage and the ability to vary the E/I ratio, export capacity give the EWA to generate large amounts of low cost, low impact, high value water. Indeed, Games 4 and 5 demonstrate clearly that, without adequate access to export capability, south of Delta storage is relatively worthless. In both Games 4 and 5, the EWA was unable to put a single drop of water into groundwater storage and had to rely almost exclusively upon water purchases to generate environmental benefits.

Just as important, if the Projects gain control over all new export capacity at Banks and in the Delta Islands, the risk to EWA assets and the environment rises to unacceptable levels. The reason is that major take events frequently take place during high flow periods in the spring. If the Projects are able to pump, not at 10.3 kcfs, but at 15 kcfs or even 21 kcfs (using Delta storage intakes), then the cost of reducing export pumping to environmentally protective levels quickly becomes prohibitive. For example, reducing the export pumps from 10 kcfs to 5 kcfs costs the EWA 10 kaf/day. But reducing exports from 15 kcfs to 5 kcfs costs the EWA 20 kaf/day, a doubling of the EWA cost. Over several weeks, this difference can amount to enormous amounts of water. Moreover, without guaranteed access to the export pumps, the EWA will have a difficult time paying back this amount of water through increased pumping. Thus, the EWA is forced to rely very heavily upon markets. In turn, support for market access by EWA could collapse.




Thus, on the one hand, access to export capacity is key to the development of low cost, low impact high value water by the EWA. On the other hand, new export capacity under the control of the Projects represents both a degradation of the environmental baseline and a major new draw on limited EWA assets. This problem will only get worse if export demand rises in the future. Therefore EWA should control a major share of new export capacity, if not a share of existing capacity.

How to divide capacity? My initial thinking is based upon the following considerations:

- Avoid interfering with existing contractual rights as much as possible.
- The Projects currently control all existing export capacity.
- Increased export capacity provides limiting returns to the Projects. That is, the first kcfs of new capacity provides more benefits than the next kcfs etc.
- Increased export capacity probably causes accelerating damage to the environment. That is, the first kcfs of new capacity probably causes less damage than the next kcfs etc.
- Increased export demand causes new environmental damage.

Therefore, the EWA needs to receive an appreciable share of any new export capacity merely to be able to mitigate for the new damage caused by the higher pumping rates resulting from new infrastructure and increased demand. Then, if the EWA is to provide for environmental enhancement, it must receive an additional share. In an attempt to integrate all of these considerations, I created the following function:

EWA share of new export capacity = $(1\text{-}k)Q^2/Qmax + (2k\text{-}1)Q$

Where

k= Fraction of total new capacity going to EWA when capacity is at maximum
Q = Actual level of new export pumping (not total, just the new increment).
Qmax = Maximum level of potential pumping (if hydrology were favorable). Thus, for months when pumping into Delta islands is forbidden, Qmax would only reflect capacity at Banks and Tracy. Qmax would rise for months when Delta intakes are available.

The function would not apply to use of new export capacity for market transfers or storage transfers.

This function has the property that when Q = 0 (i.e., when no new pumping capacity is on line), the EWA share of pumping is 0. When Q = Qmax, then the EWA share of the new capacity = k, which, as I have





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said, should probably be > .5. When Q = Qmax, dE/dQ = 1. Thus, the Projects get the first increment of new capacity, the EWA gets the last.

If we set k = .6 and Qmax is 8 kcfs (e.g., a scenario where new Banks pumping and 4 kcfs of Delta island diversions were all potentially available) then we would get the following division of rights:

This function tends to meet the specifications I presented before. The Projects get most of the first increment of capacity. The EWA gets most of the last increment. The cost of driving exports down from very high levels (e.g., 19 kcfs) to lower levels (e.g., 14 kcfs) is relatively low, since the reduced pumping comes mostly out of lost EWA storage, not Project storage. As the Projects drive up exports to service increasing demands, they will automatically drive up EWA assets as well. I am aware that continuous, polynomial functions such as this are seen as too complex for government work. We could substitute a simple step function and get to more or less the same place. I merely note that step functions create operational distortions by creating incentives for operators to move just above or below the break points of the steps.

In my conception, the EWA would not be required to share capacity when pumping is above the E/I ratio (though a similar function could be written which gives the projects an increasing share of pumping as pumping rises above the E/I standard).

I propose that we run a future game using this kind of distribution of property.

**Delta Storage and Water Quality**

The water quality impacts of Delta storage has become a major question mark. Delta storage is clearly of great value to the EWA. However, the storage may be associated with high TOC, particularly if storage is tied directly into Clifton Court Forebay. (CCF) If we conclude that Delta storage connected to the CCF is a water quality problem, we have a number of possible responses:

- Seal the islands with clay.
- Dig out the peat. This has the added benefit of increasing storage potential, increasing the depth of storage, and providing fill for use in habitat restoration.
- Reduce residence time. We could generally evacuate the islands very quickly after filling.
- Deliver water only to meet agricultural demand on the DMC. This requires an intertie from Bacon/Victoria to Tracy and the O"Neal Bypass. The idea is to hold water until ag demand on the DMC is high enough to absorb all the capacity from Bacon/Victoria. Then, empty Bacon/Victoria solely for agriculture. Other federal pumping would be shifted to CCF using the JPOD. This would keep TOC out of urban water and would probably reduce salt loading for agricultural as well. It would constrain Bacon to filling only once per winter, however.
- A related idea would be to draw water out of Bacon and to release it into the Mendota pool during the salmon outmigration period to boost flows and to increase Delta outflow (or to be backed into upstream storage for the EWA). (This is like Alex Hildebrand's recirculation approach, but without rediversion at the bottom). This would, incidentally, reduce the need for the EWA to purchase water on the SJR for flows (unless there were specific tributary needs.). This is especially important if we have overestimated market water availability or underestimated the price. I guess, some of the TOC would get back into the Projects, but the water would be diluted, particularly during the VAMP period (with limited exports and closure of Old River). We could even think about an in lieu arrangement in which we supply the water in return for credit from the exchange contractors (thus allowing us to get some of the water back in the export area). Apparently an exchange of this sort has already been negotiated by water users.
- A similar idea would be to use this water to make deposits into the Gravelly Ford groundwater site, again via the DMC. The TOC problem disappears, and we get long-term storage.

Delta storage is a major study area within CALFED's Integrated Storage Investigation (ISI). The DNCT should probably communicate any insights it has on the need for Delta storage and desirable operational characteristics of Delta storage to the ISI.

**Project Benefits from EWA**

The EWA appears to provide net water supply benefits to the Projects in two ways: though this statement still needs to be confirmed.

- First, there is the interaction between diversions and X2. My impression is that the EWA has tended to clip off high Delta outflows through increased diversions, and to increase Delta outflows at lower flow levels. Because the relationship between Delta outflow and the movement of X2 downstream is logarithmic, improvements in Delta outflow at low outflows have a much greater positive effect on X2 than reductions in outflow at high outflows. This could mean that the EWA is helping, on average, to meet the X2 standards through its operations. If so, then either the EWA should get credits for this water, or it needs to be added to estimates of improved project yield.
- Of course, if the opposite is true and the EWA is making compliance with X2 more difficult, then the EWA must compensate the Projects.
- Second, there is the issue of the San Luis low point. As I understand it, in most years, the Projects attempt to operate SLR such that minimum storage (in August) is greater than some specified amount. This carryover storage will constrain Project deliveries. **The existence of EWA water in San Luis in the late summer allows the Projects to deliver water below their previous low point.** Another way of putting it is that the EWA is providing the dead storage in San Luis, or that the Projects are borrowing EWA storage in San Luis. Now, the Projects will not necessarily gain water supply out of this maneuver. If San Luis doesn't fill and the EWA doesn't have storage in San Luis the next summer, the projects would have to reduce deliveries and would be right back where they started. But when SLR fills, the Projects will have increased their deliveries. This is just the opposite of demand shifting by EWA.

**Accounting for Changed Operations**

The first conclusion I draw is that the EWA requires multiple accounts – one for every reservoir in which it controls or owes water and perhaps others as well. The idea that EWA "credits" can simply be applied anywhere in the system simply cannot work. Water developed through increased exports cannot simply be transferred into an upstream reservoir without risk to those water users serviced by the reservoir. Therefore, the EWA needs multiple accounts, with the possibility of transferring water from one account to another if circumstances permit.

Up to now, we have relied upon a base model run for our accounting. When an EWA operation changed releases or diversions compared to the modeled rate, the EWA either gained or spent assets. In real operations, there is no baseline. Therefore, we need to develop a methodology for computing the degree to which EWA actions have increased or decreased releases and diversions.

There are several ways to proceed:

1. Develop an accurate model about how the Projects operate in real life, in real time. This model can then provide the basis for an accounting system.[2] I view this approach as infeasible.
2. Negotiate baselines as we go. The Projects will estimate what their operations would have been except for EWA involvement. We will then assess credits and debits based on how operations with EWA

[2] For example, a model might be based upon the assumption that: (1) The Projects always divert all the water they can at the first available opportunity and (2) The Projects always release the least amount of water they can while still satisfying downstream flow and water quality standards

involvement differed from this baseline. This approach has been used with some success over the past several years. However, as the EWA begins to act more frequently, this approach runs into conceptual problems, since over time, the Project baseline will no longer represent Project operations without EWA, but rather Project operations in response to past EWA actions. This destroys the concept of the baseline. This approach has promise, but it needs modification.

3. The simplest approach will be to keep accounts, not on an instantaneous basis, but on a seasonal basis. If we can aggregate our accounts in this way, then we need not worry so much about instantaneous baselines, but can settle our accounts at the end of a season – e.g., at San Luis high point and low point.

Let me present how we might do the accounting for exports first. Then we can consider interactions with upstream storage.

- The computation of EWA export water asset gains should be straightforward. The EWA will acquire water in the export area by (1) granting an E/I variance, (2) using excess Project pumping capacity, (3) transferring water from upstream or from an export user, or (4) using export capacity which the EWA controls. In each of these cases, we should be able to compute how much export water is controlled by the EWA and we will know where in storage the water lies. We can also keep track of the way EWA assets in San Luis Reservoir may "spill" as San Luis fills. Once the sum of Project storage plus EWA storage in SLR reach maximum storage, EWA storage is diminished by the amount of pumping foregone by the Projects because they have no place to put the water.
- The computation of EWA export debits will be slightly more difficult. We cannot simply count up export reductions demanded by the EWA or we may force the EWA to pay twice for the same water. I believe the solution lies in the assumption that the Projects will make every effort to fill San Luis Reservoir before the agricultural growing season. Therefore, each year, the EWA debt to the Projects in the export area would be calculated at the high point in San Luis Reservoir. The debt would be computed as:

  > Any carryover debt + the lesser of (1) the volume of Project exports which were foregone due to EWA action and (2) unused Project storage in SLR.

  The EWA would then be responsible for paying back this debt plus any debts incurred after high point,[3] before low point in SLR. Or the EWA could make arrangements with the Projects or other agency for carrying over debt past low point.

This approach has the advantage of freeing us from the burden of coming up with the baseline operations which would have existed if EWA took no action to reduce exports. We do need to estimate real time base operations (i.e., what would the Project have exported each day, given the existence of the EWA), but this should be relatively straightforward. Also, we should be able to estimate the debt before high point is reached with fairly high accuracy so that the EWA and the Projects can judge how much debt is safe and what operations need to be taken to generate needed water.

One possible weakness is that the Projects could conceivably modify Project operations in ways that create spurious EWA debts to the Projects by lowering high point storage in San Luis. For example, the Projects might shift water into some other reservoir. Or MWD might take early delivery of its water and hold the water in the East Side Reservoir. Similarly, in the drier years, the Projects could delay the transfer of storage from upstream reservoirs to San Luis. However, we should be able to handle these kinds of problems. Because the debt is the lesser of EWA reductions and unfilled SLR storage, this problem will only arise in years when San Luis would have filled, but for operational manipulations by the Projects to keep SLR from filling. Thus, holding water upstream during dry years is unlikely to be a problem. Moreover, we should be able to expand beyond SLR to include all south of Delta storage in our computations.

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[3] Debts incurred after high point do not risk being double counted and so can simply be tallied up on a daily basis.

Upstream accounting is largely analogous to export accounting. The EWA may gain control over water in upstream storage by purchase, by backing up water from downstream, by exchange with the Projects, by developing water in EWA controlled storage, or by selective relaxation of instream flow standards (analogous to relaxing the E/I ratio). The EWA spends upstream water by releasing water above the flows that would otherwise occur, or by selling or exchanging the water. EWA water may spill if storage levels begin to intrude upon low priority EWA water. Again, the negotiation of a daily "baseline" will be needed in order to compute how much EWA is spent during release. Projects will frequently release water at minimum regulatory flows, but sometimes, they may release at higher levels in order to supply downstream demands or generate power.

**Linkage of EWA to Water Quality**

We have discussed the possibility that EWA might be given responsibility for improving export water quality. I believe that this would be a bad idea. With the EWA, we are giving empowering an environmental trustee to take discrete actions to achieve substantial environmental enhancement. We presume that the trustee will become very clever in pursuing the interests of its clients (the fish). Water agencies have always had this kind of discretion. If, now, we force the EWA to also attempt to enhance water quality, we confuse its mission with possibly conflicting goals. It may be appropriate to force the EWA to do no harm to water quality, on average. This would be in keeping with the "no harm" foundation of the EWA. A "no harm" requirement could be measured in terms of annual salt or TOC load, for example (but with the possibility that a reduction in salinity might compensate for an increase in TOC, and vice versa). The EWA could probably meet such a requirement without major gymnastics. To go further than this is to create managerial confusion about priorities.

**Linkage to ERP Flows**

CALFED is simultaneously proposing the creation of an EWA, and the purchase of $20 million worth of upstream flow enhancements. It makes no sense for these to be separate programs. The upstream flow enhancements are easily accommodated within the EWA approach and there should be substantial cost savings attached to considering Delta actions and upstream actions simultaneously. For example, upstream flow releases will frequently enhance Delta outflows, or could be pumped by the EWA in the Delta. Similarly, EWA export reductions may allow water to be backed up into upstream reservoirs, or EWA export water might be traded for upstream storage. Thus, there are substantial benefits to putting all flow related CALFED actions under the umbrella of the EWA.

**Linkage to CVPIA b(1), b(2) , and b(3) Water**

This is a more sensitive topic, but the same logic applies to CVPIA environmental water. The b(1), b(2), and b(3) water in the CVPIA, taken together all have analogs within the EWA.

- b(1) water represents reoperation of the CVP to yield more environmental benefit without water purchases and without cost to the contractors. The EWA is capable of catalyzing the same operational changes through trades with the CVP.
- b(2) water represents the use of a sort of "property right" to enhance the environment. In this case, the property right is 800 kaf of CVP yield (as defined by deliveries during the canonical drought). The EWA is based upon the idea that environmental property rights can be deployed to protect the environment.
- b(3) water is water purchased to supplement needs not met by b(1) and b(2) water. The EWA also relies heavily upon water purchases.

There are differences, however, between the way that the CVPIA is being implemented and the way we envision the implementation of the EWA:

- CVPIA flow patterns have been based upon fixed AFRP flow targets – a set of quasi flow standards designed to help double anadromous fish. Unlike actions within the EWA, AFRP actions are fixed and are not to be altered in real time.
- Environmental rights to the b(2) water are not well defined. It is not clear whether the environment controls water itself, or whether the environment merely is able to force release of water to help meet AFRP flows (and thereafter loses any right to the water). For this reason, no accounting system has ever been developed to track environmental water and it is very difficult to control, manipulate and reuse b(2) water as is done by the EWA.
- Operational shifts for the environment are developed cooperatively by the USFWS and the CVP. The USFWS does not have the right to manage environmental water as it sees fit.

I would argue that, in general, the approach taken within the CVP to date is inferior to the proposed structure of the EWA in the following respects:

- The EWA is able to modify flow patterns in real time.
- The EWA has control of real assets – water, facilities, purchases. It is able to shift resources around in time and space to optimize protection. Thus, it is able to shift resources to a particular place or it can hold resources across years to focus protection on certain types of years.
- The EWA is able to act unilaterally – it does not need the permission of the Projects for many of its activities.
- Through its ability to provide collateral for proposed activities, the EWA should be able to gain Project approval for operational shifts that the Projects would never otherwise accept.

This suggests that CVPIA water and the EWA water should be merged under a single umbrella, with the overall administration similar to what is now proposed for the EWA. This would require that the CVPIA b(1), b(2), and b(3) authorities be converted into the asset-based approach of the EWA. There do not appear to be any major obstacles to this conversion:

- An EWA which incorporated CVPIA water would have the ability to implement b(1) type actions through agreements with the CVP.
- The b(2) water could be quantified and allocated to an EWA through a number of mechanisms. The simplest approach might be to allocate enough high priority storage in CVP facilities to an EWA to reduce CVP yield during the canonical dry period by 800 kaf. The EWA would control all water captured by this storage and could hold the water, release it, sell it, trade it, etc.
- The b(3) water simply represents funding available for all operations of the EWA, including purchase of water, storage, and conveyance.
- The AFRP "standards" would need to be softened to allow for some discretion on the part of the EWA to maximize benefits.

Given these modifications to the implementation of the CVPIA, the marriage of the CVPIA water and the EWA would be very powerful. The CVPIA would bring in enormous upstream assets into the umbrella. The CALFED portion of the new EWA would bring in new funding, rights to vary some SWRCB standards, and access to export pumping capacity.

**A VAMP/ EWA Accounting Issue**

The VAMP experiment calls for 30 days of export reductions in April and May, coupled with upstream flow releases to assist in the downmigration of San Joaquin salmon. The nominal starting time for the export reductions is April 15, though this can be changed, based upon evidence that salmon are moving down the rivers earlier or later than this date. Exporters have supported the experiment on the condition that all export reductions are paid back. The CVP portion of VAMP may be met using b(2) water (is this right?). My only point is that the starting date for the VAMP experiment has significant implications for export water impacts. In general, as VAMP is begun earlier in April, export impacts increase. This is a result of the natural tapering off in Delta flows over the spring. If the EWA is required to implement

VAMP using its own resources, there is no accounting problem. However, if VAMP is treated as a standard with no payback required, then shifting the start date of VAMP will have variable impacts on the Projects. This could cause distortions in operating approaches. During the gaming, we have already seen the biologists move up the start date of VAMP in order to reduce costs to the EWA of paying for additional export reductions. I suggest that the EWA should either be made responsible for reimbursing the Projects for VAMP, or for reimbursing them for any additional costs caused by moving VAMP forward in time (plus receiving credits from the Projects for delaying VAMP).

EWA

DNCT Modeling
February 16, 1999

Issues Surrounding Sharing of New Facilities
for Modeling Purposes
David Fullerton

Concept: As new facilities or actions are taken to increase diversions, the EWA will acquire certain rights for the use and control of those improvements.

Examples: JPOD: Whenever water is exported under JPOD, EWA will control a certain percentage. USBR is obligated to provide conveyance as far as San Luis Reservoir for the EWA water.

Expanded Banks: Whenever the SWP exports water above permitted capacity, EWA will control a certain percentage. The SWP is obligated to provide conveyance as far a San Luis Reservoir for the EWA water.

Delta Storage: EWA controls both a fraction of diversion capacity and a fraction of storage capacity. EWA water in Delta storage is high priority -- i.e., it does not spill.

Operations: New facilities/actions may be associated with new regulations. These regulations would create a new baseline. If new regulations are stringent, presumably, EWA's share in the new facilities/actions, would be reduced. As a starting point, assume that new facilities/actions are only subject to existing regulatory controls.

Similarly, if the E/I ratio is eliminated, this would create a new baseline. The EWA would receive compensation either in the form of a contract for water from the Projects (discussed elsewhere) or in the form of a greater share of the new facilities/ actions, in the form of higher priority storage at San Luis, or through some other means.

The Projects (USBR for JPOD, SWP for expanded Banks, one or both for Delta Storage) may elect to use their facilities whenever allowed by regulations. In such cases, EWA automatically is granted its share of pumping and the projects must provide conveyance for EWA water when relevant.

If EWA cannot use its share of pumping (e.g., storage is full and there is no environmental demand), the EWA may either forbid the use of its share of capacity, or may lease rights to its capacity to the Projects or other water users.

If EWA wishes to suppress Project pumping by new facilities (JPOD, Expanded Banks, filling Delta storage), it must use its assets.

EWA may initiate use of new facilities/actions. The EWA cannot ask for diversion of water greater than available conveyance capacity. When EWA initiates usage, the Projects have an option to control water up to their assigned fraction of the pumping. If the Projects assert their option, they must provide conveyance for the corresponding amount of EWA water as far as San Luis. Otherwise, water will be moved for the EWA only as capacity is available. This capacity may be limited by requirements to leave surplus capacity available for use in a water market or by any other Project activity (e.g., delivering "surplus" water to contractors).

Rights to storage will be negotiated. As an initial assumption try:

- Lowest priority rights to San Luis
- High priority rights to any storage acquired specifically for EWA
- Input and output capacity to and from storage in proportion to the percentage of EWA storage at various facilities, with the option to utilize unused input and output capacity.

Rights to conveyance are described above. The Projects must give high priority to shared diversions from JPOD and expanded Banks, but not to water pumped solely for EWA.

This description merely represents a starting point for modeling. One outcome of modeling may be to alter the mix of assets and priorities assigned to the EWA.

# USE OF WATER FROM FLEXING THE E/I RATIO TO FILL AN EWA CONTRACT

BACKGROUND

The 95 WQCP permits flexing the E/I ratio away from its default levels in order to reduce entrainment effects on fish.

This option has been little used because:

> It is seen by waterusers as an assumption of risk on their part unless the replacement water is pumped in advance of ecological need and
>
> The regulatory agencies have been hesitant to pre-pump water because of a lack of facilities for holding water until entrainment becomes a problem. In addition, under the terms of the Plan any pre-pumped water must be used within six months.

Thus, the default levels have been the main regulatory tool to reduce entrainment and entrainment of delta smelt has exceeded the take limits.

THE PROPOSAL

The volume of water retained in delta channels due to the E/I ratio varies by month and hydrology, but generally is greatest when fish are most likely to be present and flows are low.

Modeling of changes to the E/I ratio could be used to translate given sets of hydrological conditions into increased annual deliveries of the projects. The increased deliveries could be directly translated into a new contract to contribute to the EWA each year. This contract could be written in such a way that its delivery would not interfere with other deliveries; a time and place of use at San Luis Reservoir on August 30 would ensure adequate storage space was available. This delivery could then be traded for other volumes of water that would otherwise be exported at times of fish entrainment.

The modeling would need to identify all pertinent features that combine to make the impact of the current E/I ratio requirement an actual decrease in project annual deliveries, rather than a simple shift in the timing and volumes of exports into other times of year. Such model parameters as San Luis carryover, upstream carryover, and the levels of valley accretions in each month. The E/I ratio tends to increase carryover storage so impacts on winter-run cold water pool requirements would also need to be considered.

By closely tying the contract delivery volume to hydrological characteristics where the present E/I ratio constrain operations, the regulatory agencies could be ensured that that level of protection could always be.reinstituted. However, the ability to offer the contract amount as collateral would greatly facilitate the restriction of exports on an as-needed basis.

The delivered contract amount each year would probably vary inversely with other contract amounts. The 90% exceedence forecasts in February and March would probably tend to overpredict the delivered amount of the contract.

Modeling could be done under a variety of flexible options:
1. At times of year when salvage is dominated by sudden sharp increases, the present E/I ratio is probably most ineffective (thus replacing the limits from May 15 to July 30 with an EWA contract is probably most effective
2. At times when salmon smolts are outmigrating, the broader protection of the E/I ratio may serve to provide a low level of protection over a longer period of time so that retention of some level of E/I requirement would give confidence to fishery managers that rarer species were not being protected (Thus replacing the present limits with a 45% limit from November through April 15 and dedicating any yield above the current level into an EWA).
3. The E/I ratio in its present form can shift more quickly than the general hydrodynamics of the estuary. Thus, replacing the limits with an EWA contract could be limited to times when X2 is below Chipps Island.

II. Policy Issues and Problems:

The 1995 WQCP will require emendation to permit translating the present requirement with a contractual agreement. This probably cannot happen unless all parties are in favor.

Secondary impacts of a replacement with some or all of the E/I requirements with an EWA contract may have secondary impacts. Such impacts might include carryover storage for winter-run and upstream reservoir release requirements for salmon spawning.

Export manipulations in years when the EWA contract would be largest might produce unacceptable changes in water quality or stage in the south delta.

Entrainment of species in years when the E/I contract amount is small ( probably mostly in critical, above normal and wet year types) will need to be addressed through other means.

The joint point of diversion is likely to have an impact on yield in years when the E/I ratio would have little effect. Together the two tools might ensure an EWA that is adequate to significantly reduce entrainment in all years.

III. Technical questions

What hydrological features are the best predictors of increases in total annual deliveries from flexing the E/I constraint?

Likely candidates include:

Nov-Apr monthly upstream storage and 8-river index
Nov-Apr monthly SLR storage and delta inflows
Feb-Apr 50% exceedence forecasted Sacramento Index

What is priority status of contract? Is it the most junior or is it highest since it is based on an implementation of a standard? (Same question would apply to a gallon-for-gallon account). If it is junior, how can the accounting system assure that other users aren't simply increasing their demand to take all water supplied by the E/I flex?

How much does delivery forecast vary from month to month within a year? Do the conditions accompanying this contract conflict with reliability goals for other contractors?

What are the consequences to water quality, water stage, and power accounts:

1. If the contract actually is taken as an increased delivery in some years instead of being used as collateral for a desired pumping outage? How much more energy is used to pump the additional water and how are those costs reimbursed? If the additional pumping can be identified as occuring at times when the E/I ratio is greater than the default values called for in the WQCP it may be easy to track the secondary impacts. These impacts can be approximated through DWRSIM or similar tools.
2. If the contract is used to impose pumping restrictions without impact on total deliveries? The timing of those restrictions may have impacts which will depend on unforeseeable biological triggers. These impacts might best be anticipated during the gaming process.

Psuedo Minutes
DNCT Water Acquisition Team Meeting
March 9, 1999
David Fullerton

This is really a summary of what was said and decided at yesterday's meeting. I did not take detailed notes so this is based to some extent upon my (admittedly weak) memory. I will present the group's proposal for the first iteration of the game at tomorrow's meeting and then write up the result after it has been chewed on some more by the group.

Attendance:

David Fullerton
Ed Winkler
Brent Walthall
Spreck Rosekrans (by phone)
Jim Snow
David Forkel
John Mills
Ron Ott

Agenda

1. Develop a procedure for generating scenarios for use in the DNCT gaming exercise.
2. Construct one or more scenarios for presentation back to the modeling committee on March 16.

Notes.

Overview — DF distributed a draft to the committee, giving an example of how to generate information of use in the gaming exercise (attached), as well as a possible scenario for the game. Most of the meeting was devoted to working through the draft and making modifications to it.

Procedure — The group developed a matrix format for presenting scenario information. The problem is fairly complex. The water supply scenario will depend upon the target year (because more measures may come on line with time), the measures selected, the gross division of benefits between water users and the EWA, how that division of benefits is accounted for, the baseline selected for purposes of modeling (i.e., the prescriptive requirements assumed to be in effect), what measures are to be modeled and which to be manipulated by hand, and the operational characteristics of the measures (e.g., input and output capacity). The committee decided that, since we may need to generate and communicate numerous scenarios, that a standardized procedure was necessary.

1. Create a time line, showing what measures might be on line at what time in the future. Then, to create a scenario for any given year, a vertical slice through the timeline will show what water supply improvements might be available at a given time in the future.

2. Create, for any given target year, a matrix along the following lines:

| Modeling Baseline = | | | Target Year = | |
|---|---|---|---|---|
| Possible Water Supply Measures | Selected for Scenario? | Operational Characteristics | Division Between EWA and Users | How to Model How to Game |
| Various kinds of storage | yes or no | | | |
| Various kinds of transfers | | | | |
| Variances to prescriptive rules | | | | |
| New infrastructure | | | | |

< Related to storage >

3. The DNCT will also need to develop rules to allow the game to go forward. Those rules should be specified for each scenario. Possible rules were presented in DF's attachment.

Scenarios The group grappled with the problem of scenario proliferation. The DNCT modeling committee decided that the gaming exercise would not be based upon the analysis of large numbers of permutations (at least not initially). Rather, the DNCT would game one scenario, modify that scenario, then run the game again. In this way, the group hopes to converge fairly quickly upon a solution that represents the best that can be done with the tools available. On the other hand, each scenario includes numerous explicit and implicit assumptions. For both technical and policy reasons, we will need to vary those assumptions. But we create a new scenario each time we change an assumption. The kinds assumptions which at least one participant has asked to var are as follows:

1. Target Year. All sides want to know what assets and/or supplies they will have available at the outset. Improvements in assets and/or supplies over time will also be of interest. For simplicity, the group decided to start with a single target year -- Year 4. In year 4, CALFED will be half way through Stage 1. The EWA and water users should have more assets than at Year 1, but fewer than available in Year 8 at the end of Stage 1.

2. Modeling Basis. This not quite the same as the "baseline for purposes of counting benefits" that has caused controversy within CALFED. It includes all hardwired features of the system that can be modeled. It

Includes standards, AFRP flows, Trinity River releases, etc. (It therefore will be partially determined by the bio team.) It also includes changes to infrastructure or operational rules that can be modeled, such as JPOD, south Delta improvements, etc. There we some desire to develop different modeling bases resulting from policy differences, particularly AFRP in-Delta requirements. However, for now the group decided to go with a single set of bio requirements which included AFRP in-Delta, Trinity flows, etc., since they do represent Federal policy. This means that a greater number of new assets will need to be assigned to the Project operators, if their water supply bottom lines are to be met.

3. Accounting. There are at least 2 and perhaps more approaches to accounting. There is strict accounting, in which the EWA owns facilities and develops its own water. There is a more conventional approach in which the Projects owns the facilities, but is required to grant the EWA certain rights against the Projects, and numerous intermediate points (for example, the Projects control some facilities, but are required to deliver water to the environment for use <u>or</u> for storage in environmental storage). The group decided to develop one scenario of each type: one in which the EWA controls water and facilities and one in which it does not control facilities, but simply has an annual call on the Projects.

Results

The group decided to develop 2 scenarios: one with, one without infrastructure ownership by EWA for the Year 4 target year. The scenario is similar to the Year 1 scenario from DF's March 9 proposal, with the addition of Delta storage, additional efficiency purchases, small enlarged Shasta, and new groundwater at Gravelly Ford.